SCIENTIFIC AMERICAN

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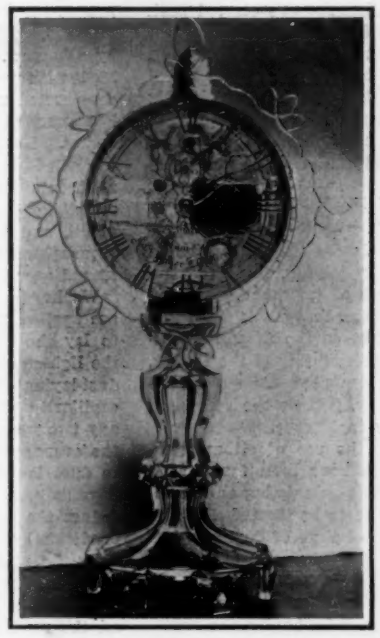
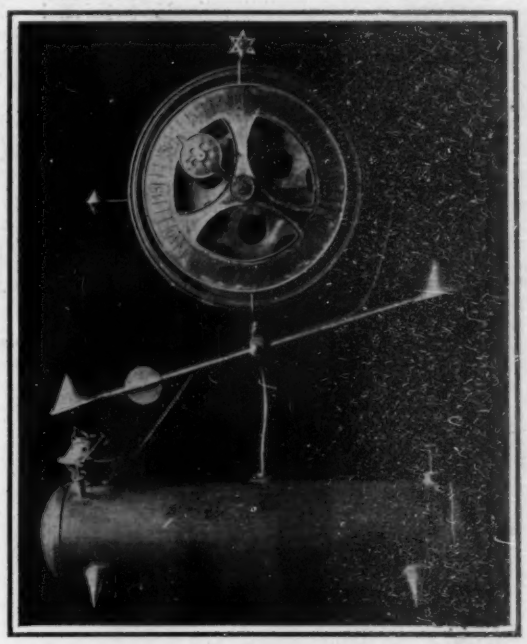
Glass-incased German clock.



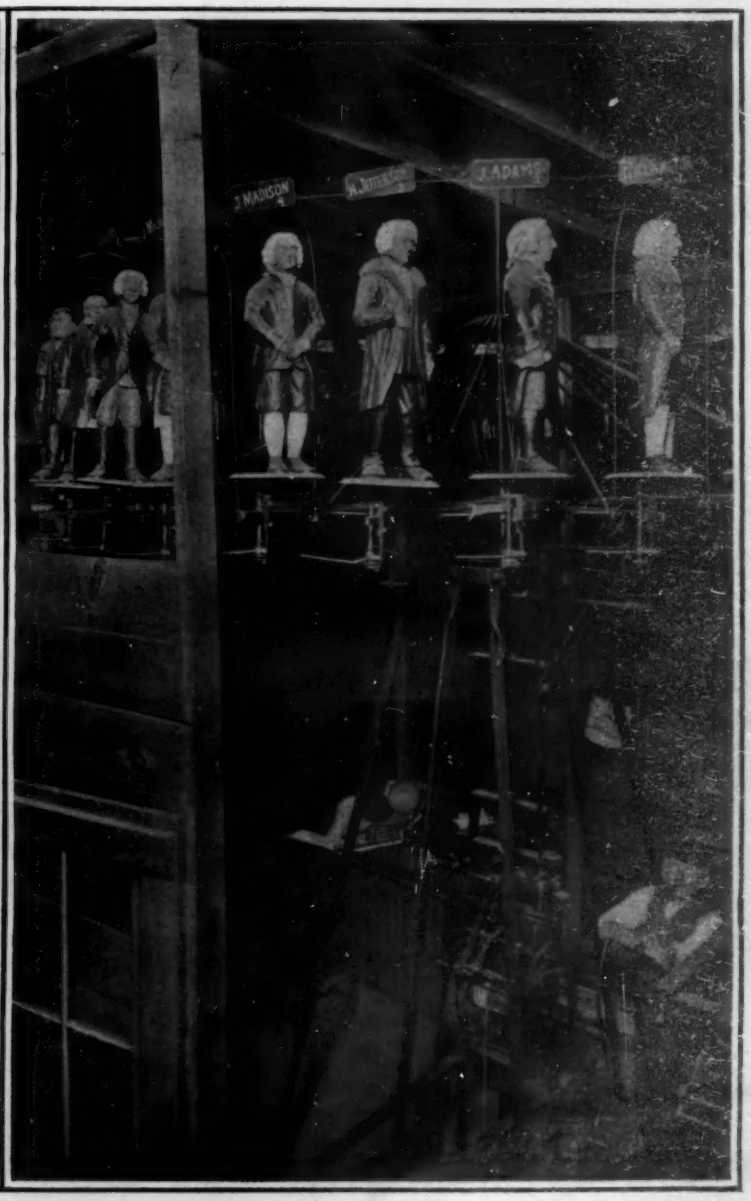
Crystal clock built in Bohemia.

Italian wicker clock.



French clock operated by heat.

The five dials of Bohacek's wonderful clock.



In Bohacek's clock the Presidents each appear in turn.

MANY CLOCKS OF MANY WAYS.—[See page 178.]

SCIENTIFIC AMERICAN
ESTABLISHED 1845

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NEW YORK, SATURDAY, SEPTEMBER 3rd, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TO LIMIT OUR FOREST FIRES.

THE resistless sweep across some of the richest forests of the Western States of this season's conflagrations, with their frightful toll of human life and destruction of valuable timber, is appalling and altogether discouraging. In casting about for remedial or preventive measures, by which the progress of these fires can be arrested and confined within limited areas, the most feasible method would seem to be that of the provision of fire avenues, of the same general character as those which are doing such good service in the forest-covered sections of Europe.

For many reasons it is impossible to establish and maintain a system of forest protection as elaborate and efficient as those abroad. The principal difficulties in the way of this are the vast areas to be covered, and the relatively high cost of labor. The European forester makes his calling his life business, knowing that if he give faithful service, there is before him a life job. He is clothed with considerable authority; in many cases he possesses the power of arrest; and his position is strengthened by the certainty that punishment for breach of the laws, and particularly those against fire, is swift and sure. The pay, however, is so small that it is possible to maintain in Europe a force which would be altogether out of the question in the United States.

Under existing conditions, it would seem that the most effective way to safeguard our forests would be to cut through them a network of fire avenues, following the European practice of making the width of the clearing twice the height of the tallest timber through which it is cut. In Europe the avenues in some forests will be found at intervals of half a mile; here they would be opened at intervals of from two to five miles, according to the configuration and value of the forest lands. The cost of the work, if it were judiciously laid out and properly executed, might be covered largely, and in some localities altogether, by the sale of the timber. The avenues could be so located with regard to the streams and rivers or the slope of the country, that the timber might be shot to the streams and floated out, or hauled out by sleds when the ground was snow covered. If the cleared avenues were seeded, it would be possible to rent the grazing privileges in consideration of the owners of the stock keeping down the undergrowth.

THE THOUSAND-FOOT OCEAN LINER.

MARINE construction, both naval and commercial, is advancing by such leaps and bounds that we look, within the near future, to see the seven-hundred-and-fifty-foot warship and the one-thousand-foot ocean liner. At present, apparently, the only influence which is limiting the size of ships is the question of harbor accommodations; for there are but few channels and no drydocks that could accommodate vessels of this size. The sudden jump in the dimensions of warships has been phenomenal; and the launch last week of the British cruiser-battleship "Lion," with a length of 660 feet between perpendiculars, a displacement of 26,350 tons, and a probable speed of 28 or 29 knots on trial, marks an advance for which there has been no parallel in the history of warship construction. Comparing the armored cruiser "Cressy" of 1900 with the "Lion" of 1910, we find that the length has increased nearly 50 per cent, the displacement over 100 per cent, and the total broadside gunfire has risen from 1,360 pounds to 10,896 pounds. What the next ten years will bring forth is a matter of pure conjecture. At present, there are no signs whatever of any slowing up in the rate of increase in size, speed, and power. The same growth in dimensions is noticeable in the merchant marine. When the "Lusitania" and "Mauretania," with their maximum displacement of over 40,000 tons, and their over-all length of 790 feet, came into this port, it was predicted that, because of lack of pier accommodation, and the limitation put upon draft, these vessels must stand for many years as marking the limit of practicable size. Nevertheless, two giant ships, the "Olympic" and "Titanic," are being pushed to completion by the White Star Line at the Belfast yard, which will exceed the Cunarders by as great a margin as they did any previous ships. The length has gone up to 860 feet, which means that if they are to dock on the North River, some 40 to 50 feet of the ship must project into the fairway. But the end is not yet; for the Hamburg-American Line has recently started work on a vessel that is to be 880 feet in length, and whose displacement is to exceed that of the White Star liners, reaching a maximum on full-load draft which is stated by the company to be 60,000 tons. Unless the big ship should elect to dock at the new city wharves in South Brooklyn, it is difficult to understand where she can be accommodated.

DUST PREVENTION ON PUBLIC ROADS.—II.

IN our last issue we dealt with the subject of permanent binding materials for the prevention of dust on public roads, explaining, more particularly, the use and effect of tar when employed for this purpose. The various heavy oils have the same permanent binding effect as the tars; and, because of the abundance and accessibility of the former, they have been the chief permanent dust-preventive materials used in this country, just as the tars have been used almost exclusively in Europe.

The methods employed in the use of oil are generally similar to those which have been found suitable for tar applications. When an existing and somewhat worn macadam surface is to be treated, the surface should be swept fairly well clear of dust, particular care being taken to remove all organic material. All holes, ruts, etc., should be filled in, and the surface brought up to a uniform condition. In applying the oil, care must be taken to insure its having the necessary fluidity. If it has sufficient viscosity, when it is cold, to penetrate the road surface, for reasons of economy the oil should be so applied, and heating should be resorted to only when it is necessary, which is the case with all the heavy oils.

If oil be applied during the construction of a macadam road, particular attention should be paid to the question of drainage. The sub-surface is constructed in the usual manner, each course being thoroughly rolled; and, if water is used, time should be given for the road to thoroughly dry out. The hot oil is then applied and any excess is absorbed by covering the oiled surface with a layer of sand and screenings.

Gravel roads are treated in the same way as macadam roads, and here also particular care should be taken to insure thorough drainage. Ruts and holes must be filled, and a uniform surface insured. Where the lateral drainage is poor, the whole surface must be lifted up, graded, and given the proper crown. Should the surface be loose and clayey, it is advisable to thoroughly work the oil into the top course by raking. The road should then be compacted by a thorough rolling. This is particularly important, for if it be omitted, the traffic will force the oil up, producing a soft, spongy surface—a condition which is harmful to vehicles and uncomfortable for pedestrians.

The State of California has done particularly good work on its gravel roads, and the following digest of the methods employed will be found of value: Before the gravel is laid, the underlying surface is graded and rolled. Upon this is placed, first, a bottom layer of gravel containing no stones larger than 2½ inches. After this has been rolled, a 3-inch layer of gravel containing no stones larger than one inch is placed and rolled. Oil is then distributed, at the rate of one-half gallon per square yard, and covered with clean sharp sand until no oil can be seen. After an interval of twelve hours, another application of oil and sand is made, and the surface is rolled until the roller ceases to make any impression.

We must go to California again for reliable information on the subject of oiling earth roads, for it was in that State that the practice was first tried in this country. At first, crude petroleum was sprinkled on the road merely to lay the dust. It not only proved to be an effective dust preventive, but in certain localities it achieved such permanent improvement in the condition of the road surface that public interest was aroused, and much experimental work was carried on with more or less success. Although, because of local conditions, California is more favorable for the oiling of earth roads than most other States in the East and middle West, the lessons learned there are valuable for general guidance in earth road construction. The character of the soil naturally plays an important part. It has been proved that alkali in a soil disintegrates the oil, and prevents its properly binding the material. The best results were obtained in a sandy loam. Clayey soils proved the most difficult to treat, since they do not absorb the oil and have a tendency to ball up and become lumpy. This can be remedied, however, by the addition of a proper amount of sand. As in the case of macadam and gravel roads, good drainage is all important. Care should be taken not to over-oil a dirt road, as this will produce a spongy surface and cause heavy going for vehicles. Lastly, a dirt road is serviceable only as long as it is kept in thorough repair. Ruts and depressions should be immediately cut out, oiled, filled with selected earth or sand, and thoroughly tamped to the level of the surrounding surface.

In another California method which has given satisfactory results with roads of sand, clay, loam, and gravel, the road is plowed to a depth of six inches and crowned. Then all clogs and lumps are broken up by a harrow. Next, the roadway is thoroughly sprinkled with water and consolidated with a specially-constructed rolling rammer, the lower portion of the loose earth being compacted to a depth of about two inches. Next, one and a half gallons of heavy asphalted oil are applied to each square yard. The road is then tamped again, lightly harrowed, and slightly watered. Then follows another application of oil, and a third tamping. Finally, the surface is thoroughly rolled, and a slight covering of earth is spread over the surface to take up any excess of oil.

We have already stated that the temporary binders are applied at more or less frequent intervals merely to lay the dust. They include water, salt solutions, the lighter oils and tars, and various emulsions. The dust-laying quality of water is due to the force of capillarity, which produces a mechanical bond between any two wet surfaces. The effect ceases entirely with the evaporation of the water. The value of the salts in dust laying is due to the fact that some of them have so great an affinity for water, that they not only reduce the rate of evaporation, but prolong the moist condition by absorbing the water from the atmosphere. It is the magnesium chloride in sea water that rendered it attractive for this purpose; but sea water is objectionable on account of the gray scale that is left on the road, and the bad effect of the salty mud on the varnish and iron of vehicles.

Among the salts, calcium chloride, which is obtained as a by-product in the manufacture of soda, has been applied successfully, and to a slight extent, in the United States. The solution is sprinkled from an ordinary watering cart, and a road so watered remains dustless long after the effect of an ordinary watering would have ceased. Among other salt preventives that have been used is one consisting of a mixture of soda, sodium chloride, and lime.

In addition to water and salt solutions, a third type of temporary binder is the light tars and oils. Part of these are applied in their natural state, others in the form of water emulsions. Those which are applied in their natural condition generally act merely as palliatives, as is the case with water. Others, such as the vegetable oils, paraffine, petroleums, and certain of the tar oils, contain a small amount of permanent base. They evaporate more slowly, but leave behind some binding material which tends to permanently cement together the fine material of the surface, with the result that at the end of a season's treatment, the road itself will exhibit an improved wearing quality. Water-gas tar, which can be had for about three cents a gallon, is one of the most effective temporary binders that can be applied in its natural state. In using this material, and the lighter semi-asphalted oils, the middle of the road should be given twice as heavy a treatment as the sides.

Considerable success has been achieved with emulsions of oils or fats with water, the mixture being made either chemically or mechanically. Chemical emulsions are oily substances which are saponified, and so made miscible with water. It is impossible to enter into any detailed description of these; but the type which has been used more extensively than any other in this country is the asphalted or semi-asphalted oil emulsion, with which good results have been obtained on several of the park roads in Boston. The emulsion is prepared by adding 18 pounds of cottonseed oil soap to 50 gallons of water, and mixing 50 gallons of this solution with 100 gallons of crude petroleum and agitating until the emulsification is complete. The emulsion is then considerably diluted with water and applied to the road.

For more detailed information upon this important subject, reference is made to the most valuable literature published by the United States Department of Agriculture, under the Office of Public Roads.

Major-Gen. Frederick D. Grant, in his annual report on the Department of the Lakes, advocates a law authorizing the Federal government to commandeer for the transportation of troops in time of war all private automobiles holding four or more persons. He also advises the construction of automobile trucks for the transportation of supplies to the field.

ENGINEERING.

Japan gives bounties for the construction of ocean ships by native shipbuilders. Also she gives navigation subsidies to all 12-knot ships of over 3,000 tons that are owned by Japanese. The policy seems to work well, the registered tonnage of steamers having risen from 657,000 tons in 1902 to 1,189,957 tons at the end of 1909. At the same date there were 239 private shipyards and 55 private docks in Japan.

The bulletin of accidents on steam railways in the United States for the first quarter of the present year is very discouraging. The total number of persons killed was 1,100, and of injured 21,322, an increase of 466 killed and 6,110 injured, as compared with the same quarter in 1909. These figures, be it known, do not include trespassers, but only passengers and employees engaged in the discharge of their daily duty.

Last month the first of the large caissons for the new foundations of the Quebec Bridge was launched from the temporary works adjoining the bridge site. The new superstructure will be 30 feet wider than the old one, and the new center line of the bridge has therefore been moved 15 feet up stream. The caisson measures 54 feet by 180 feet and weighs 1,700 tons. The caisson of the south pier, 79 feet by 180 feet, will be the largest of its kind ever built.

Unless remedial measures are taken, it is possible that the famous leaning tower of Pisa may ultimately collapse as did the Campanile at Venice a few years ago. Measurements taken by an English engineer in 1829 showed the tower to be 15½ feet out of the perpendicular. Measurements taken recently show that the divergence has increased to 16½ feet. It should be within the resources of modern engineering to excavate below the tower, bring it gradually back to the vertical, and place beneath it an absolutely secure foundation.

Writing in Die Turbine of the economy of the exhaust steam turbine, W. Heym makes a comparison of the first and operating costs of gas engine and combined steam engine and turbine plants. He finds that under a load factor of 100 per cent the total yearly cost of operation and maintenance of a 1,000-kilowatt steam plant, exclusive of fixed charges, insurance and taxes on land, and with coal at $3.50 per metric ton, will be $49,757, and of a gas plant, $51,000. The greatest difference in favor of the steam plant is found to be under a load factor of 40 per cent, when the total yearly cost of operation and maintenance of the steam plant is $36,750, and of the gas plant, $39,497.

In the recent paper by Mr. George Westinghouse, on electrification of railways, to which reference has already been made in these columns, a summary is given showing the total amount of steam trunk line railroad track in the world which has been electrified. Single-phase electrification has been applied to 553 miles of single track, and continuous or direct current electrification has been applied to 816 miles of single track. Of the former, the Spokane and Inland Railway leads with 129 miles. The New Haven road has 100 miles, the Midi Railway, France, 75 miles; the Colorado & Southern, 46 miles; the Rotterdam-Haag-Scheveningen, 46.5 miles; the Baltimore and Annapolis, 30 miles, and the Prussian State, 31 miles.

In total length of single track, the West Jersey and Seaport line leads among the continuous-current, electrified steam railroad systems, with a total length of 150 miles of single track. Then follow the New York Central, 132 miles, the Long Island, 125 miles, the Pennsylvania, 75 miles, the Metropolitan Railway, London, 67 miles, and the Lancashire and Yorkshire Railway, England, 60 miles of single track. The electrification of subway and elevated systems in America has reached a total of 436 miles. The longest single system is that of the Interboro Rapid Transit Co. of New York, which has 190 miles. Then follow the Chicago elevated systems with 113 miles, the Brooklyn Rapid transit, 71 miles; Boston elevated, 19 miles; Philadelphia Rapid Transit, 11 miles, and the Hudson and Manhattan, 12 miles.

On June 18th the first steps were taken to form a permanent organization to be known as the American Society of Engineer Draftsmen, embracing every branch of the profession, including mechanical, electrical, civil, architectural, marine, sanitary, automobile and aeronautical draftsmen. The first meeting of the society was held on July 27th. Draftsmen have long felt the need of an organization which would be the means to establish a higher professional standing and would place them on a recognized professional plane in the field of engineering. The benefits of an organization of this character are well understood and need no elaboration. The qualifications for membership are such that a standard will be established, as in other branches of engineering, and it is the aim of the society to maintain this standard, and to secure recognition from every concern employing draftsmen. The headquarters of the society will be at 116 Nassau Street, New York.

AERONAUTICS.

At the Cambray aviation meeting of August 20th, the aeroplane used by De Baeder, when at a height of 100 feet, capsized and fell. De Baeder was pinned under the motor and was crushed to death.

Elbert H. Gary, Mrs. Gary, Charles R. Flint, and Frank A. Munsey recently paid a visit to the aerodrome of Blériot at Epernay. Judge Gary, Mrs. Gary, and Mr. Munsey were taken up for flights.

An A. V. Roe triplane, built in England, arrived in this country and is to be used at the Harvard Aero Meet, at which some eighteen American and foreign aviators, with at least fourteen makes of aeroplanes, will compete.

A German aviator named Vollmoeller killed a boy at Stuttgart on the 15th of August, in one of those quick downward swoops for which Brookins, in this country, is famous, and which caused him a serious accident.

The Antoinette monoplane, which was recently brought over to this country, is now being tried out at Hempstead Plains by Harry S. Harkness. The machine has only recently been assembled, and requires tuning up before it undertakes sustained flights.

In the Garden City aviation field on August 14th, Mr. Charles F. Willard, in his Curtiss biplane, carried four persons a distance of quarter of a mile, at a height of about twenty feet. The passengers were tucked in in all manner of positions in order to keep the machine on an even keel.

Last Saturday J. C. Mars attempted to fly from Sheepshead Bay race track to Staten Island. After first making a fine flight over the ocean his engine stopped when he was above the Narrows and he was precipitated into the water. He was rescued, but his Curtiss biplane was demolished.

It is said that the French army will carry out this autumn, in connection with the maneuvers, some elaborate tests to determine the military possibilities of aeroplanes. Major T. Bentley Mott, American Military Attaché at Paris, will be assigned to watch the maneuvers by the War Department. Eight aeroplanes will be used, four on each side.

John D. Moissant, whose trials and tribulations in flying from Paris to London have provided much thrilling reading, recently announced that he had invented an aeroplane which is made entirely of aluminium. He claims that he made experiments last September with his machine in the suburbs of Paris. Because of his inexperience they were not very successful.

The French production in aeroplanes amounts to about 800 machines, all told, up to date, which represent a value of $2,500,000. The small Blériot sold at first for $2,000, but after its success in crossing the Channel the price was raised, and the latest type now costs from $3,000 to $5,000. The Farman machine now sells for $5,600, the Voisin for $4,600, the Antoinette for $5,000, the French Wright machine for $5,000, and the Sommer machine for $5,000.

Lieut. Vivaldi, of the Italian army, was killed on August 20th by a fall from his aeroplane. Vivaldi had learned how to fly at Châlons. His machine was a Farman biplane, which made its first flight when he was killed. Upon his fatal trip he was accompanied by Lieut. Savoia in another machine. Vivaldi flew on to Civitavecchia, 38 miles from Rome, while Savoia turned back. When near Rome, on the return journey, Vivaldi met his death. Just why his machine failed him is not known. He fell from a great height. As usual, the wrecked machine told but little of the cause of the accident.

The Board of Governors of the Aero Club of America has decided to invite Curtiss to defend the speed trophy which he won at Rheims a year ago last August. His two associates have not as yet been selected, but no doubt Hamilton will be one of them. Curtiss won the trophy over the crack fliers, including Blériot. His speed was forty-seven miles an hour at the time, which, however, was exceeded at this year's meet. J. Armstrong Drexel, who recently broke the height record, has been invited to bring his European-built machine to the international meet. The Wrights have promised five machines for the contest, but have said nothing in detail about their characteristics.

L. L. Gillespie, chairman of the subscribers' committee which has raised the funds for the international meeting, reports to the Aero Corporation, Limited, that $125,000 has been subscribed and that the committee is now preparing to lend this amount to the Aero Corporation to conduct the contest. The aviators will be permitted to share in the net profits of the meeting, and there will be cash prizes approximating $50,000. Of the first $100,000, after paying the necessary expenses, the aviators are to receive 70 per cent, and of all sums beyond this they are to get 40 per cent. The distribution will be made on some graded scale to the winners. All the expenses of the aviators are covered.

SCIENCE.

Prof. Richard L. Garner, who still believes that monkeys can talk, arrived recently in this country after having spent some time in the jungle studying chimpanzees and gorillas. He last sojourned at Lake Fernan Vaz, in the French Congo.

How bright is the sun? Some time ago C. Nordmann outlined a method of finding out. His method consisted in determining the intrinsic brightness of the sun. Recently, he drew attention to the values obtained by other workers using different methods, citing those of Muller (100,500 decimal candles per square centimeter), Fabry (184,000), and Pickering (352,000). Nordmann's value (319,000) lies between the two latter determinations.

The Parker-Brown Mount McKinley expedition has failed to attain its object, namely, the climbing of Mount McKinley. The members of the expedition assert that they have conclusive evidence that Dr. Cook did not reach the summit. Prof. Parker, who headed the expedition, took photographs of lower peaks. He places no credence in the assertion made by Tom Lloyd of Fairbanks and his associates, that they climbed the mount from the Fairbanks side.

The action of radium in changing the color of glass and precious stones is well known. The first practical application of this property seems to have been made by a London chemist, who has used radium to bleach brown diamonds, improve the color of soiled pearls, and deepen the color of emeralds. He has no great hope that the process will ever be of commercial value, because of the high cost of radium, and also because artincial stones are made so cheaply nowadays.

In the Phys. Zeitschr. Messrs. J. Elster and H. Geitel show that the so-called potassium salts exhibit a slight radio-activity, thus confirming the results obtained by other investigators. With the object of separating off a more active substance which might possibly occur in potassium, different salts were subjected to chemical processes or treated as solutions by electrolysis. All these experiments, however, led to negative results, showing that the activity of potassium must be ascribed to the metal itself. Special experiments were also made to find whether any emanation is given off from potassium salts. These experiments also led to negative results.

The Blue Hill Meteorological Observatory is celebrating the twenty-fifth year of its existence. When he founded the observatory in 1885, Mr. A. Lawrence Rotch was a graduate of the Department of Mechanical Engineering of the Institute of Technology. The observatory was first occupied by Mr. Rotch and his observer, Mr. W. P. Gerrish, on February 1st, 1885, and observations have been continuously made since that time under unrivaled and identical conditions of exposure. The observatory was one of the first institutions in the United States to be equipped with self-recording instruments, and is one of the few in the world to-day where nearly every element is continuously recorded. No other institution has studied the upper and lower air so long.

In Le Radium Mme. Curie gives a detailed description of the comparison of the amounts of radium in different solutions by means of the emanation accumulated in a known time. The solution containing radium is placed in a closed "bubbler" and the emanation allowed to accumulate. Air is then bubbled through and, along with the emanation carried with it, passed into an ionization chamber, where measurements of its activity are made. After suitable corrections these are compared with the measurements of the activity due to the emanation from a standard solution of radium in a similar apparatus. It was found that with due precautions measurements could be made by this method with an accuracy of 0.5 per cent. The maximum current from an amount of emanation equivalent to 1 gram radium was calculated to be 3.5×10^3 e. s. units, the chamber being 12 centimeters high and 6.7 centimeters in internal diameter.

In the July number of the Astro-Physical Journal, Mr. Frederick Slocum discusses the condition of the sun on May 18th and 19th, 1910, during the transit of the head of Halley's comet. The photographs which he took at the time show that the most conspicuous feature on the sun was a group of spots near the center of the disk. Since this group developed some time between April 28th and May 11th, on the invisible side of the sun, its connection with the comet is, of course, out of the question. There was much activity on the 18th and 19th, as shown by the photographs, as well as changes in the location and number of small spots. The calcium spectroheliograms show conspicuous changes in the arrangement of the flocculi and in the distribution of the eruptive jets. The prominence plates show only ordinary conditions. On May 18th at 5 hours and 56 minutes there were 15 prominences, none of unusual size or intensity. It may be safely stated that the transit of the comet was accompanied by no unusual solar phenomena.

SOME MODERN METHODS OF ASTRONOMICAL DISCOVERY

BY HENRY NORRIS RUSSELL, PH.D., PROFESSOR OF ASTRONOMY IN PRINCETON UNIVERSITY

The discoveries which have added to our knowledge of the heavens are so varied in kind, as well as so great in number, that it would scarcely be possible to give an account of them all in a small compass. If, however, we put aside those which relate to the theoretical side of the science—such as the law of gravitation—and limit our view only to those which reveal to us new heavenly bodies, or new features of those already known, the subject becomes more manageable. Such discoveries fall naturally into two classes—those of actual newcomers in the heavens, and of objects which might have been found sooner, had they been sought with suitable instruments and methods.

To the former class belong the great bulk of the comets. Their appearance is absolutely unexpected, and, if they are bright enough, they may first be detected with the unaided eye by some amateur, or even by one who is not an astronomer at all, as actually happened in the case of the great comet of last January, which was first seen by three railroad employees in South Africa, whose duties took them outdoors before dawn. Usually, a comet is picked up, long before it becomes visible to the naked eye, by some astronomer who is sweeping the heavens with a suitable telescope, systematically examining everything in a given region of the sky so that he cannot fail to see the comet if it is there. This particular comet, as calculation shows, was almost behind the sun for some time prior to its discovery, and did not emerge far enough to one side to be visible, until it had already become very bright.

But it is the discoveries of the other kind—of bodies no brighter or more conspicuous than they had been many times before—that best illustrate the present methods of the science. The astronomers of former times had as great ability and energy as those of the present. If we are to find what they could not find, we must have some better means at our disposal.

Much, of course, depends upon the increase of instrumental power, and especially upon the invention of instruments of a new kind—such as the spectroscope—which open up new realms of investigation, previously inaccessible; but much is also gained by the devising of special methods of using existing instruments adapted to the particular problem in hand.

In both respects photography is now one of the most important aids of the astronomer. Our illustrations (which appear through the courtesy of the directors of the Harvard and Yerkes Observatories) show very clearly some of its many different applications.

The first illustrates the discovery of a new heavenly body—Phœbe, the ninth satellite of Saturn. The station which the Harvard Observatory maintains at Arequipa, Peru, for the observation of the southern heavens, possesses an instrument—the Bruce telescope—especially designed for photographing a considerable region of the sky and for showing very faint stars.

Fig. 1 is a reproduction of part of a *negative* obtained with this instrument. The great dark spot on the left shows where the light of Saturn has fogged the plate so that the disk and rings of the planet, and its inner satellites, are lost in the "glare." On the edge of this, indicated by guiding lines, are the images of two of the satellites, and on the right, at a little distance, that of Japetus, the farthest satellite previously known. The numerous black specks beyond this are images of faint stars (black because the picture is a negative) with one exception, the very faint object indicated in the lower right-hand corner. There is nothing on this one negative to show that this is not a star too; but on negatives taken on the two preceding days the stars are all in the same relative positions, while this object (as is shown in Fig. 1a, an enlarged and reversed sketch), shows a steady motion toward the star *a*. Such rapid motion shows that it must belong to our solar system; and further following showed that it was not an independent small planet, but a satellite, revolving about Saturn, at the great distance of eight million miles, with the long period of seventeen months.

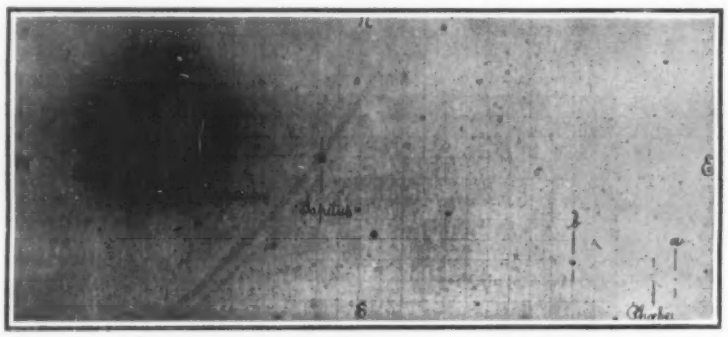


Fig. 1.—How the satellite Phœbe was discovered.

This is a negative. The great dark spot on the left shows where Saturn's light has fogged the plate. Two satellites lie on the edges of the "glare." "Japetus" lies farther out. The numerous black specks beyond are images of faint stars, with one exception, the faint object marked "Phœbe" in the lower right-hand corner. On two plates taken twenty-four hours apart, this object appears in different positions, thus proclaiming its true character.

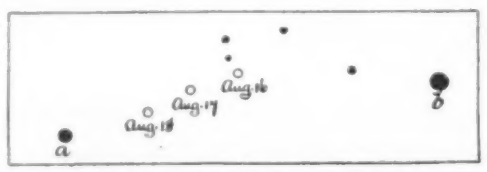


Fig. 1a.—Map showing location of Phœbe.

It is obvious that the discovery of so faint an object depends not on the power of the telescope with which the photographs were made, but rather on the patient and careful study which Prof. W. H. Pickering made of them; and that even this care would have been in vain if the possibility of superposing one negative on another, so that the images of the same stars coincided, had not assisted in the picking out of the one faint moving object.

By the same method Prof. Pickering has discovered a still fainter satellite of Saturn; Prof. Perrine of the Lick Observatory, two satellites of Jupiter, and Mr. Melotte of Greenwich, another.

The following illustrations show some of the methods employed at the Harvard Observatory in the search for variable stars—those which change in brightness from time to time.

Fig. 2 shows a portion of a negative on which eight successive exposures of half an hour each were made—the instrument being moved just enough between exposures to shift the star images clear of one another on the film. (During the rest of the time, as in astronomical photography generally, the camera was so guided that it exactly followed the apparent motion of the stars through the sky.)

For the majority of the stars the eight images are all alike; but there is one near the bottom (left)—pointed out by a black arrow—for which the middle images are almost invisible. If this were the case for all the stars, we would say at once that clouds must have drifted across the sky and obscured them while these exposures were being made. But only this particular star is affected, and so it is certain that its brightness really changed. Our first guess would, however, not be very far wrong in principle, for this is one of the well-known "Algol variables," whose light is periodically eclipsed by a dark (or at least faint) companion. In the case of this star (υ Cephei) the fainter star is bigger than the bright one, which remains hidden behind it for nearly two hours, while the interval between successive eclipses is slightly less than 2½ days.

Such a photograph makes it possible to pick out the variable at once among the dozens of stars which surround it. It is perhaps even more noteworthy for the way in which it exhibits before our very eyes the eclipse of one star by another, though the pair may well be so far off that their light takes a century or more to reach us.

This method would, however, be of no use in searching for stars whose changes in brightness occupied

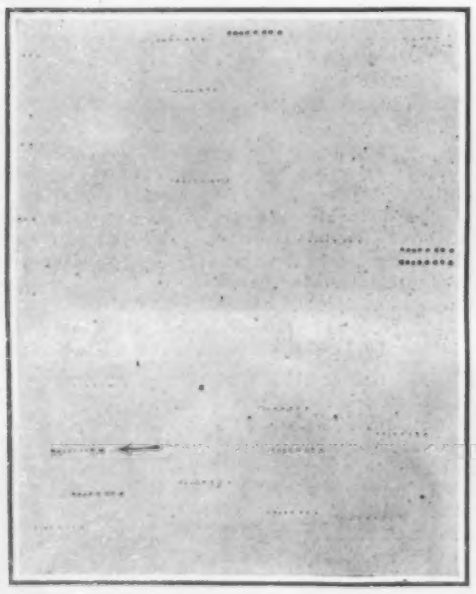


Fig. 2.—Discovery of a variable star by taking successive exposures on the same plate.

The images of most of the stars (taken at intervals of half an hour) are of equal intensity. For the star marked by the arrow the middle ones are faint owing to its eclipse by a dark companion. This is one of the well-known "Algol variables," whose light is periodically eclipsed by a dark (or at least faint) composition. This particular star is υ Cephei.

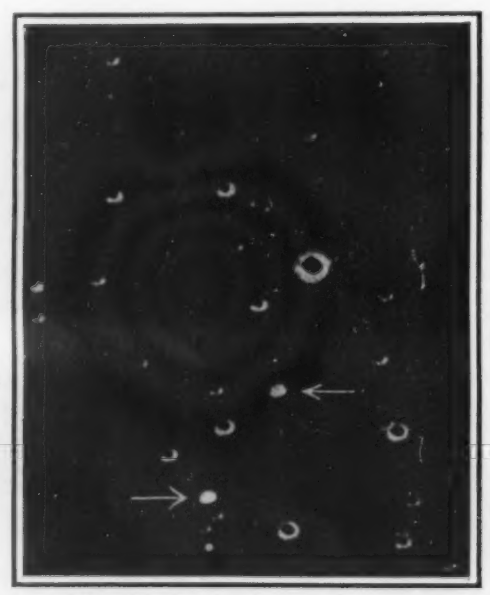


Fig. 3.—Discovery of a variable star by superimposing a positive and a negative of the same region.

The white images are the larger, so that each star on this combined positive and negative appears as a black dot with a white halo. Two stars, indicated by arrows, have no dark center. While the positive was being made these stars were bright; when the other plate was taken they were too faint to show at all. Hence they are "variables."

Fig. 4.—The star cluster Omega Centauri in which 128 variable stars have been discovered.

The multitude of small stars is almost overwhelming. Yet in this cluster 128 variables have been discovered at Harvard by the method of superimposing positive and negative plates of the cluster. By this simple method between two and three thousand variable stars have been discovered at Harvard, several times the number which have been found by all other methods combined.

weeks or months, for during a single night they would hardly vary at all.

The next illustration (Fig. 3) shows a remarkably simple and effective way of discovering such stars.

The problem is to pick them out from among the thousands of stars which show no variation.

Suppose that we have two plates of the same region of the sky, taken at different dates. Both will be negatives, and show the stars as black dots on a clear ground. Let us make a positive print from one of these. This will show the stars as white dots on a dark ground.

Now let us put the other negative on top of this positive. We can adjust them so that the black image of each star on the negative comes on top of the white image of the same star on the positive. In the case illustrated, the white images are the larger, so that each star appears as a black dot with a white border,

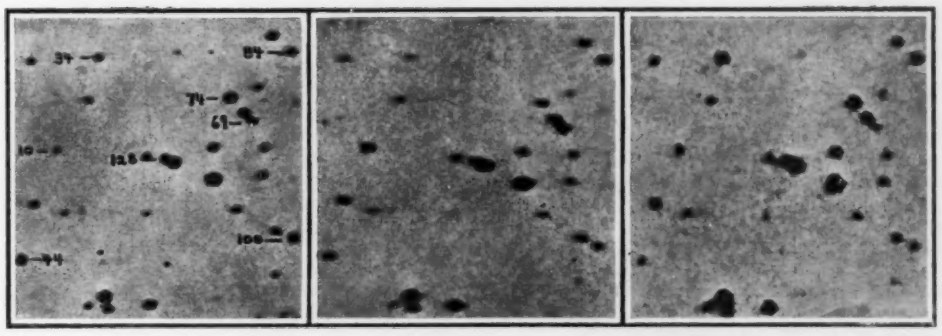


Fig. 5.—Portions of a negative of a star cluster, much magnified.

The numbered stars are variables, identified as such by comparison with the other pictures of the same stars. An interval of only two hours separates the first two plates; yet in that time star 10 among others has markedly changed in brightness.

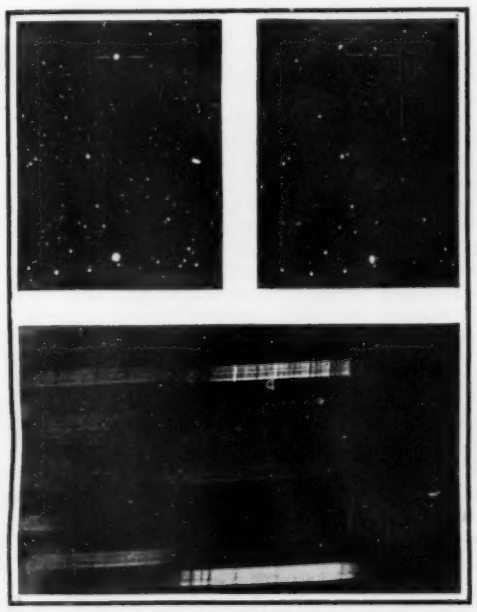


Fig. 6.—Discovery of a variable star by its spectrum.

The upper half of this photograph shows two positive pictures of a variable star (near the top) sufficiently conspicuous on comparison of the two. But the discovery was made, not from these two pictures, but from the lower one, which is a spectrograph. Differences in the spectra indicate to the practiced eye which star is a variable.

as shown in Fig. 3, there are two stars—pointed out by the arrows at the side and bottom—with white images and no dark center. This means that at the time of taking the plate from which the positive was made, these stars were fairly bright, while when the other plate was taken, they were too faint to show at all. If they had been bright when the latter plate was taken, instead of the former, they would have appeared on the figure as black dots (blacker even than the background, when viewed with a strong light) with no white border.

In this way a single case of change of brightness can be picked out from thousands of unchanging stars.

By using numerous plates of the same region, instead of a single pair, stars which, though variable, happened to be of the same brightness on the first two plates, may be found.

By this method between two and three thousand variable stars have been discovered at Harvard—several times the number which have been found by all other methods combined. One remarkable result of these studies has been the discovery of numerous variables in some of the great star clusters. Fig. 4 (a positive) shows one of the grandest of these (Omega Centauri, situated too far south for observation in our latitude). The multitude of small stars is almost overwhelming. It seems at first glance almost a hopeless task even to count them, much less to pick out individual stars, and find the few which change in brightness. Yet in this cluster, by methods similar to those described above, no less than 128 variable stars have been discovered and catalogued.

Fig. 5 shows portions of three negatives of a similar star cluster, much magnified. On the first of the three the variable stars are marked. Comparison of their brightness with that of neighboring stars on the three plates shows the variation clearly. It is especially noteworthy that the first two plates were taken at an interval of only two hours, in which short interval some of the stars (notably No. 10) had changed conspicuously.

Still another method which has been employed with great success in the discovery of variable stars is illustrated in Fig. 6. The upper half of this shows two pictures (positives) of a region containing a variable star (near the top) which is sufficiently conspicuous on comparison of the two. But this was discovered, not from these plates, but from the lower one.

This is a spectrum plate, taken with a prism in front of the telescope. The light of each star is by this means drawn out into a long line, which, by causing the stars to trail slightly across the plate at right angles to its length, is widened into a band. The dark lines which cross this are due, as is well known, to the absorption of light of particular colors (wave lengths) by the gaseous atmosphere of the stars. If the gases of the atmosphere shine more brightly than the surface of the star within, the lines will be bright instead of dark. Knowing this, the lower half of Fig. 6 becomes comprehensible. The long bright spectrum at the bottom comes from the bright star shown at the bottom of the upper left-hand picture. That at the top comes from the bright star near the top of this picture.

The spectrum of the fainter star, nearly midway between these two, is faintly visible in the middle of the lower section. The stars whose spectra are shown on the left of the lower plates are outside the field of view in the upper ones.

The lower of the two bright spectra is crossed by dark lines—which to the eye of experience disclose at once the presence of hydrogen and of calcium vapor in its atmosphere.

The upper spectrum is quite different. The end toward the blue (on the right) shows the heavy dark bands, due to titanium oxide, characteristic of red stars. At the extreme left are two heavy dark lines which again betray the presence of calcium. But still more conspicuous are two *bright* lines, due to hydrogen. The presence of bright lines in such a banded spectrum is found by experience to be an almost certain indication of variability—of long period (comparable with a year) and great range of brightness. Between two and three hundred variable stars of this sort have been discovered at Harvard in just this way.

Another quite different application of the spectroscope is illustrated in Fig. 7, which shows how a double star, too close to be separated by even the most powerful telescopes, may in certain cases be detected. It is well known that when a star is approaching us, all the lines in its spectrum appear shifted slightly toward the violet, while if it is receding, they are displaced toward the red.

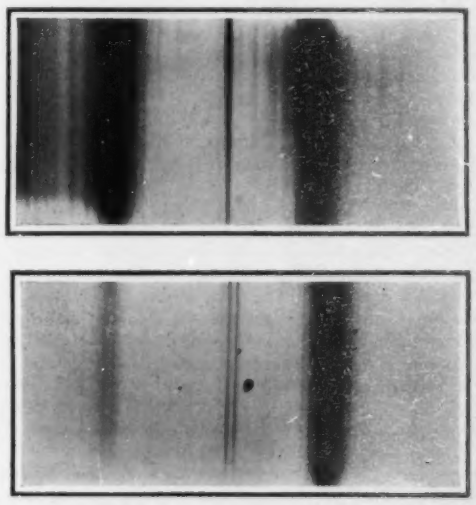


Fig. 7.—Discovery of a close double star by its spectrum.

These are photographs of the spectrum of Beta Aurigæ taken respectively on December 30th (17h. 6 G.M.T.) and December 31st (11h. 5 G.M.T.) 1889. The star consists of a pair of suns revolving about their common center of gravity. They were discovered by Doppler's principle. In other words, when their motion is sidewise it produces no effect on the spectrum lines. But when one star is coming toward us the other is receding and the two spectra are displaced, one toward the violet and the other toward the red, so that they no longer coincide and all the lines appear double, as in the lower figure.

The star Beta Aurigæ—a portion of whose spectrum, highly magnified, is shown in the figure—consists of a pair of suns, revolving about their common center of gravity in practically circular orbits with very high velocity. Their spectra are practically identical.

When their motion is sidewise—i. e., at right angles with the line joining them to us—it produces no effect on the position of the lines in their spectra, which then coincide, as shown in the upper part of Fig. 7. But when one is coming toward us, the other is receding, and the two spectra are displaced, one toward the violet and the other toward the red, so

(*Continued on page 188.*)

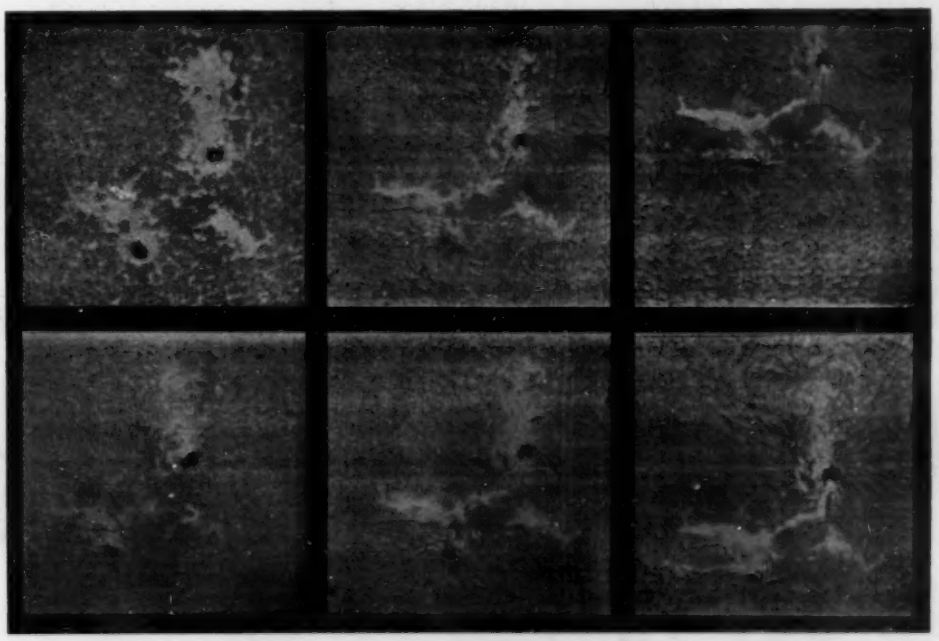


Fig. 8.—Solar eruptions connecting two sun-spots.

Photographed at the Yerkes Observatory by Mr. Fox with the spectrohcliograph. The bright regions, showing the existence and rapid changes of a giant eruption (140,000 miles long) connecting the two spots are conspicuous.

SOME NEW METHODS OF ASTRONOMICAL DISCOVERY.

MANY CLOCKS OF MANY WAYS

BY WILLIAM T. WALSH

The first mechanical device for telling the time was the sun dial. Of use only on fine days, a substitute was necessary, and the sand-glass followed. Later came the water-clock, a curious device in use among the Egyptians, Chaldeans, Babylonians, and other ancient peoples of the East. This was the first approach to a clock as we now understand the term. It consisted of a basin of water set in some public place. At one end of the basin was a spout, from which the water dropped uniformly into a receiver having graduations for marking the hours, somewhat after the fashion of a thermometer.

The clocks of to-day do not surpass or even equal those of the fourteenth and fifteenth centuries in the wonder or beauty of their construction. Clocks are common things. Every householder has at least one. We do not have to depend upon the great time-piece of church belfry or of tower. Relatively, like everything else in this modern day, because of its common character, the clock has lost something in importance. Still the charm endures of creating unusual types.

For instance, in the very modern city of Chicago the spirit of the old clock-makers lives in the person of one Franz Bohacek, a native of Patzau, Bohemia. Twenty years of careful, patient labor have seen his efforts crowned by the completion of what is one of the most remarkable time-pieces ever seen in America. In it the maker has combined the artistic spirit of the craftsman of the middle ages with the accuracy of the twentieth century man of science.

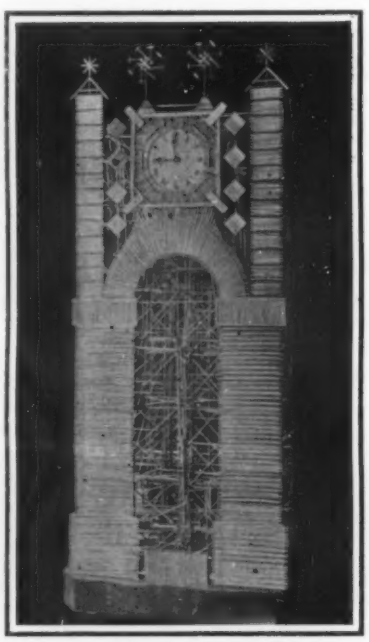
Bohacek's clock, made up of more than one thousand parts, is two stories high. Its weights are so heavy that two windlasses must be employed to wind them up. It is a very elaborate affair altogether and yet every part has a specific reason for being. It has five dials. The first of these is that of the ordinary clock—merely for telling the time of day. The second also is for that purpose, only in place of twelve numbers there are twenty-four, somewhat in the style of the old one-hand Italian clocks. On the next dial the day of the week, the day of the month, and the month of the year are indicated by three series of numbers and three hands. The fourth dial, six feet in diameter, represents the solar system, with the sun in the center and the various planets revolving about. These celestial bodies travel in exact accord with the real solar system itself. The fifth and last dial marks time, in exact, or practically exact, harmony with the laws of astronomy. As every one knows, the year consists of 365 days, 5 hours, 48 minutes, 46 seconds. Each month, thirteen in number, has therefore, 28 days, and each day consists of 24 hours, 4 minutes, 54 seconds. On Bohacek's clock, a second, as measured by ordinary clocks, is 0.00341275 of a second longer. This is not precisely right, being in a day 85/100 of a second slow—a slight discrepancy, all things considered.

This clock has many other remarkable features besides those already mentioned. There are figures that represent various events in American history. There are figures for all the Presidents of the United States, and one held in reserve. These figures appear at appropriate moments. This remarkable time-piece has many other extraordinary features, which lack of space will not permit to be chronicled here.

Another Bohemian, Joseph Bayer, a glass-cutter by trade, resident in the country of his birth, has employed glass as a medium for building a clock. With the exception of the spring every portion is of crystal glass. The three hands, hour, minute and second, as well as the apparatus for striking are all of glass. This clock is sixteen inches high.

An Italian, Sirio Tiburzi, of Fabriano, Italy, has tried his hand at a clock made solely of wicker work and poplar twigs. The dial, cord and weights are of wicker work, the remaining parts are of both wicker work and poplar twigs. The mechanism is similar to that of a tower clock with the exception of the striking parts, with which it is not equipped. It stands eight feet high and will run twenty-seven hours with one winding.

Another nationality and another sort of time-piece are represented by a straw clock of a German shoemaker. It is built wholly of this one material, of which several thousand pieces were used in the construction. There are eight pendulums. The mechanism is wound up by the pressing of a button, when it will run for five hours. The hands are set by means of another button. No spring is used. The weight of this ingenious bit of craftsmanship is seven ounces.



Bohemian clock made of straw.

MANY CLOCKS OF MANY WAYS.

The flower clock, while not so novel as some others, is still a very interesting type of the unusual clock. The single floral clock of which England can boast began to run in the summer of 1907 and was started by the Mayoress of Bridlington, where it is located. Ten thousand plants make up the dial, which is twelve feet in diameter, set in a circular bed nineteen feet wide. The dial numbers, the minutes, and the fifths of minutes are marked off, each by a different kind of plant.

A clock in a bottle is the unusual device of a German watchmaker, H. Rosin of Gommer near Magdeburg. The maker took a strong movement with a cylinder escapement measuring 45 millimeters (1.77 inches) in diameter, and began by sawing the plate into halves. The opening of the neck measures 15 millimeters (0.59 inch), and in order to get these halves into the bottle another segment was cut of each of the halves of the plate. For a resting place of the movement a sort of tripod was constructed, which was put together after its parts had been introduced into the bottle separately. This tripod was made in such a manner that it cannot turn during the winding of the movement. He fastened with screws to the platform attached to the tripod the four pieces of the plate, side by side, using for this operation a long screwdriver and other tools especially constructed for the purpose.

The plate having thus been restored to its original form, all parts of the movement were put in their original places with the motion wheels for the hands. Furthermore, he placed around the neck of the bottle a ring, of white metal, upon which was soldered a round plate, completely closing the opening. Upon this cover was fastened the arms in an inclined position, these being intended to serve for the support of the dial. The dial is made of a ground glass plate, having a diameter of 20 centimeters (7.87 inches). The figures are cut skeleton fashion, and cemented to the glass. The minute lines are painted in black. This arrangement permits the use of the timepiece for a night clock by placing a light behind the dial. The figures, which measure 2 centimeters (0.79 inch) in length, are sufficiently plain. An arbor or a staff which passes through the cover on the neck of the bottle carries at its lower extreme end a conical wheel, geared in the motion wheels, by means of which the hands may be turned. Another arbor enters the interior of the bottle until it reaches the movement, where it is connected with it by means of a hollow square, reaching the mainspring barrel and serving for the winding.

The bottle is made of transparent glass, exposing to view all the parts in the interior. Its height measures 25 centimeters (9.84 inches), and its interior diameter 7 centimeters (2.76 inches). The whole is placed upon a disk, to which it is fastened by three brackets, two of which are shown in the illustration.

As to the biggest clock, Jersey City, New Jersey, claims the honor of possessing the largest specimen in America. It crowns a factory building not far from the terminal of the Pennsylvania Railroad. The dial, which is 40 feet 6 inches in diameter, is made of yellow pine boards. Each board is 6 inches wide. The minute hand with its counterbalance weighs 640 pounds. Alone, the hour hand tips the scale at a quarter of a ton. The dial numbers are 60 inches high, and half that width. The dial works weigh 830 pounds. They are fitted with roller bearings.

A Wonderful Sensitive Balance.

Sir William Ramsay, the well-known English chemist, has recently installed at his laboratory at University College, London, what is probably the most sensitive scales that have ever been contrived, for they will weigh $\frac{1}{7,000,000,000}$ part of an ounce. So delicate is the apparatus, which has been specially designed to weigh gases such as xenon, which Sir William Ramsay discovered, that it is housed in a special underground chamber, where it is safe from oscillation and climatic influences. The task of weighing has also to be carried out in semi-darkness, as the balance is disturbed by the heat radiated from an electric incandescent lamp at the opposite end of the room, and the operator has to leave the scales for a considerable length of time, and then read the indication instantaneously before variation in temperature can affect it. The scales are carried in a special metallic chamber. The short beam and its slender supports are made of silica, which is less susceptible to effect from heat than glass. The tray is suspended from the beam by a hair of silica fiber, and the gas used in weighing is in an infinitesimal though known quantity, sealed in a glass tube of diminutive proportions. When the tube with its gaseous contents is placed on the tray, the movement of the beam is so slight that the eye cannot trace it, and special recording arrangements are adopted. The slight movement of the beam caused by the weight of the tiny tube causes a small mirror, upon which is focused a pinhole of light, to oscillate. Six feet away is a graduated black scale, upon which the pinhole of light is thrown from the mirror, and the weight of the tube with the gas is thus registered, but the operation has to be made instantaneously. The gas is then released from the tube, and the latter weighed once more. This time the scale registers one-seven-thousand-millionth part of an ounce less than it did before, which difference represents the weight of the above extremely infinitesimal quantity of xenon. It is impossible to secure weights less than the $\frac{1}{1,400,000}$ part of an ounce other than by means of gases. The limit possible with metal for practical use is this minute fraction, and Sir William Ramsay possesses a fine strand of aluminium, finer than the finest hair, and one-twenty-fifth of an inch in length, which weighs this amount. It is possible, however, to obtain a section of aluminium weighing $\frac{1}{8,400,000}$ part of an ounce, but as such cannot be seen except with the microscope, it is of no practical value.

Cold Storage of Hailstones.

Prof. Weinberg, of Tomsk, Siberia, recently published a description of a method of preserving hailstones until winter by placing them in a little chamber, suitably protected against the influx of heat, and provided with double walls, the space between which was filled with a mixture of ice and copper sulphate. In this way the hailstones were kept, at a temperature slightly below the freezing point, until the temperature of the outside air had become low enough to allow them to be examined under the microscope without melting. In the course of two years Prof. Weinberg observed only one hailstorm, which occurred on August 15th, 1909, while traveling from Aland to St. Petersburg. The fall of hail continued three minutes. The hailstones were small, ranging from 1½ to ⅛ inch in diameter. Weinberg collected several ounces of them and placed them in the cold storage chamber, after having immersed them in a mixture of equal parts of benzine and toluene, in order to prevent agglomeration. The hailstones, preserved in this way, were carried to Tomsk, and in December were brought to Moscow. After making this first experiment, Weinberg has concluded that it will be preferable to keep only a few hailstones, immersed in a very viscous liquid of density nearly equal to their own, such as cylinder oil, castor oil or vaseline. Last winter Prof. Weinberg made and polished three sections of the preserved hailstones, which he photographed on autochrome plates with a polarizing microscope. These hailstones showed no peculiarities of especial interest, but, by preserving better specimens and examining them in the same way, our very imperfect knowledge of the origin and formation of hailstones can, doubtless, be greatly improved.

Correspondence.

"TYPOSCRIPT."

To the Editor of the SCIENTIFIC AMERICAN:

I think I can help one of the correspondents out in his search for new words to express modern ideas. Why not use the word "typoscript" for typewritten copy? The only word which would seem to fill the requirements for describing the making by machinery would seem to be mechanufacture, but would not that be a rather clumsy word? I. P. HODGE.

Stewartville, Minn.

HOW THE INDIANS MADE ARROWHEADS.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of the SCIENTIFIC AMERICAN I notice a report of flint arrowheads being made with a sharp nail. Similar methods were employed by some of the Indian tribes. The Klamaths and Modocs made theirs with the rib of a deer, sharpening the point until it resembled a narrow chisel, and chipping out pieces of the flint.

Among the plains Indians generally—my positive knowledge extends only to the Otoes and Pawnees—they were all made by pounding, the rough chunk of flint being hammered first on one edge and then the other, the tendency of the rock being to "run out" as it chips off, instead of splitting through the middle. This was a much faster way than with the bone chisel, but a much larger proportion was spoiled in making. CHESTER CLARK.

Nashville, Tenn.

"MECHANIPULATE."

To the Editor of the SCIENTIFIC AMERICAN:

I should like to add a line in defense of the proposed word "mechanipulate." I think that the word has much reason for defense. It is a more specific term than machine or mechanize. The idea which the word conveys could not be expressed short of saying "manipulate by the machine." To say that the article is machined does not convey the exact idea, for that implies the altering of the thing as well. Likewise mechanize is even more vague, meaning, "To form by contrivance." There seem to be but two choices to express the idea; either to say manipulate and have the same latitude given it in meaning as is given to "manufacture" or, better, to use the word mechanipulate, for which there can be but one meaning. Since lexicographers at present do not seem to include machine work under the term manipulate, I think it not out of order to introduce the more satisfactory term. EARL A. ROBINSON.

THE ESPERANTO CONGRESS.

To the Editor of the SCIENTIFIC AMERICAN:

Your readers will doubtless be interested in a brief account of the International Esperanto Congress, which closed its sessions in Washington city, August 20th. From the standpoint of recognition by the various governments of the world, this congress attained greater success than the five previous congresses taken together. At the Dresden congress two years ago two nations sent official delegates; at Barcelona last year three nations were officially represented; this year at Washington thirteen nations responded to the invitation issued by the State Department to send delegates to the Esperanto Congress. About half of these delegates addressed the congress in the new international language. The others used their own national languages, but everyone of the representatives expressed unqualified approval of the movement on the part of the government he represented, and those who did not speak in Esperanto promised to do so the next time they attended the congress. The Chinese delegate spoke in his own language, but a Philippine delegate translated it into Esperanto. The speech was an unqualified approval of Esperanto and ended "Vivu Esperanto." Eighty-three foreigners were present as delegates in the congress, including the thirteen government representatives, and delegates were in attendance from thirty-five States of the American Union. Four States sent official delegates representing the State governments.

The most interesting part of the congress was the fact that good Esperanto speakers from all over the world were understood perfectly by those present.

A good deal has been said about the possibility of an international language being spoken by the different nations of the world in a manner to be comprehended all over the world. If there was any question on this point before the congress, it is completely answered now. Mr. Chavet of Paris, permanent secretary of the International Congress, spoke in Esperanto in which it was impossible to detect any brogue. He was understood as well by American Esperantists as were speakers from this country. Mr. Plich from Croatia spoke an Esperanto that sounded precisely like American Esperanto. It was difficult to believe that we were listening to men whose native tongue was radically different from our own and who did not understand a word of English. The Croatian delegate had only begun the study of Esperanto in May of the present year, yet he made two impromptu speeches during the congress in excellent Esperanto. There are now over a million earnest missionaries preaching Esperanto throughout the world. It would be as impossible to stop the Esperanto movement now as it would be to stop the propagation of the Christian religion. We have an international language in actual practical use. It is being taught in the schools of many nations. It has already been made use of in twenty-one international congresses relating to other subjects than Esperanto. At the great medical congress in Budapest last year an Esperanto section was organized, and two hundred Esperantist physicians attended the section. This was the only section of the congress in which even one-fourth of the members present could understand the papers that were read or take part in the discussion of them.

A great deal more testimony on the efficiency of Esperanto as a means of international communication could be given, but both my time and your space forbid. W. J. SPILLMAN.

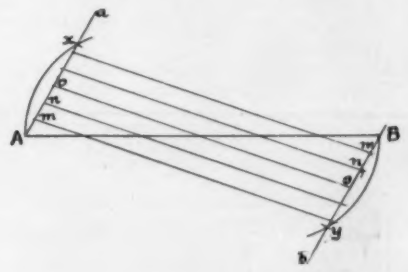
U. S. Department of Agriculture.

HOW TO BISECT A LINE.

To the Editor of SCIENTIFIC AMERICAN:

The first thing that occurs to the reader of your correspondent Herman L. Schimpff's proposition "How to divide a line into equal parts" is: prove it. A brief analysis of the elements show that it is inexact, and not even sufficiently approximate to give satisfactory results in most cases. The lines drawn through the points set off on the circular arcs will be neither parallel nor equidistant.

The correct method, which is fully as simple, is as shown in the accompanying diagram, to draw the lines *Aa*, *Bb*, through the points *x y* equidistant on the arcs



Ax, *By*, and lay off spaces at *m*, *n* and *o* on these straight lines; subsequently joining corresponding elements as shown. As this is merely a variant of a well-known proposition of Euclid, it will hardly require special demonstration.

Milwaukee, July 12, 1910. GEORGE W. COLLES.

DR. HARRIES AND SYNTHETIC RUBBER MANUFACTURE.

To the Editor of the SCIENTIFIC AMERICAN:

Dr. C. Harries of Kiel, Germany, who has recently attracted much attention as the discoverer of a process for the manufacture of synthetic rubber, enjoys the distinction of being the first to work out the molecular formula of caoutchouc, and of dispelling the mystery which had surrounded its structure. He added ozone to washed and purified caoutchouc, thereby obtaining an explosive substance which he called ozonite, and which has a formula of $(C_{10}H_{16}O_6)_2$. Prof. Harries then converted this ozonite into levulinic acid, which is an acetone derived from succinic acid. Structurally, he showed the caoutchouc molecule to be a polymer of cyclo-dimethyloctadeine.

Special agent Henry Studniczka, writing from Birmingham, England, in the issue of Consular and Trade Reports of May 28th, 1910, says: "The invention of Dr. Harries is based on the boiling together, under certain conditions, of isoprene with acetic acid in a closed tube, the result being the creation of a gray composite possessing all the properties of pure rubber and capable of being vulcanized in the same manner as gutta percha."

While from a scientific point of view Dr. Harries's work marks a distinct step in advance, yet his process is open to the same objections that were urged against a process devised by Sir. W. A. Tilden nineteen years ago.

Tilden in 1884 recognized isoprene, which he converted into a solid rubber-like mass, in the most volatile portions of the distillate of turpentine and certain vegetable oils. In 1891 he inclosed several specimens of isoprene thus obtained in flasks, and after several months he found the liquid, originally limpid and colorless, had been converted into a syrupy mass in which there floated rather bulky yellowish lumps, which on further examination he found to possess all the properties of caoutchouc. He attributed this formation to the generation by oxidation of a small quantity of acetic or formic acid, which in turn induced the transformation of the remainder of the mass. This may have been by enzymitic fermentation. Synthetic rubber was thus produced nineteen years ago, and yet it has not become a commercial product because the raw material, isoprene, is only obtained either as one of the three principal products of the destructive distillation of caoutchouc, or in such a small percentages from turpentine and vegetable oils, that the resulting synthetic rubber cost more than hard fine Para rubber gum, which was lately listed at $2.43 per pound.

It may be practical to refine some of the cheaper rubbers by Dr. Harries's process and thereby increase their value threefold, but what is most needed is a commercial process of making isoprene.

Rochester, N. Y. WILLIAM P. MUNGER.

HOW TO DOUBLE THE LIFE OF STANDING POLES.

To the Editor of the SCIENTIFIC AMERICAN:

After careful investigation, I am convinced that if that part of the pole, at and near the ground line, could be preserved and made to last as long as the bottom and top of the pole, it would double the life of the pole. The preservative qualities of crude creosote oils are now well established, and the only difference of opinion is: The best method of applying it. Government experts tell us that the preservation depends upon the penetration, therefore, to get a perfect preservation it is necessary to get a perfect penetration.

Being officially connected with our local telephone company for the past five years, and during this time having studied the preservation problem thoroughly, I at last discovered a method of applying the preservative to that part of the pole near the ground line where decay first takes place. The method, however, is so simple that I wonder why it has never been thought of before.

Bore a three-quarter-inch hole nearly through the center of the pole, about a foot above the ground line, then screw into this hole a pipe reservoir holding sufficient creosote oil to thoroughly saturate all the wood below where the reservoir is attached. Diffusion immediately begins to take place, and in the course of a few weeks every part of the pole becomes saturated below where the reservoir is placed. The reservoir can be left upon large and valuable poles, so that treatment can be given annually or semi-annually.

In one of my treatments a very peculiar condition took place. I set a nine-foot pole about four feet in the ground, and attached a pipe reservoir, two feet long, about six inches above the ground line. I gave this pole one gallon of creosote; two months later I refilled the reservoir, and shortly after was surprised to find the oil oozing out of the top of the pole, four and a half feet above the entrance to the pole, and two and a half feet above the top of the reservoir, and I am now convinced that if the reservoir be refilled from time to time that eventually every part of the wood in the pole would become saturated. This is due no doubt to some form of attraction, probably caused by the heat of the sun. To those who doubt the effectiveness of our method and treatment, I submit the following question: If you were to place a block of wood in such a position that drops of oil would fall upon it constantly, would not that block of wood in time become thoroughly saturated with oil? This is exactly what our device and method does for standing poles of all kinds.

Brookville, Ind. JOHN C. MORIN.

The Current Supplement.

In the opening article of the current SUPPLEMENT, No. 1809, our Berlin correspondent describes the manufacture of quartz goods, which are now so widely used.—The mother-of-pearl industry in the south seas, especially that of the Society Islands, is described.—A. N. Lurie describes a precision slide rule.—The Anderton electric-driven canal-boat elevator is made the subject of an interesting illustrated article by Mr. Frank C. Perkins.—A summary of the concluding lecture of Sir J. J. Thomson before the Royal Institution on light and electro-magnetism is published.—The problem of transmitting optical energies by aid of the telegraph wire has at different times attracted the attention of inventors. A new device of the kind is described by Henry Sutton.—The continuation of Mr. Titcomb's paper on "How Fish are Hatched" will also be found in the current SUPPLEMENT.—Some new investigations in physics are mentioned and briefly illustrated.—G. Loucheux discourses at length on the sterilization of liquids by ultra-violet rays, and describes the practical apparatus which has been introduced for that purpose.—Mr. C. P. Willis concludes his instructive article on "Preservative Treatment of Farm Timbers."—Prof. Tamassia, of the University of Padua, bases an entirely new method of identifying persons by the pattern of the veins in the back of the hand. His system is discussed.

THE NEW WRIGHT BIPLANE

THE ABANDONMENT OF FRONT HORIZONTAL RUDDERS

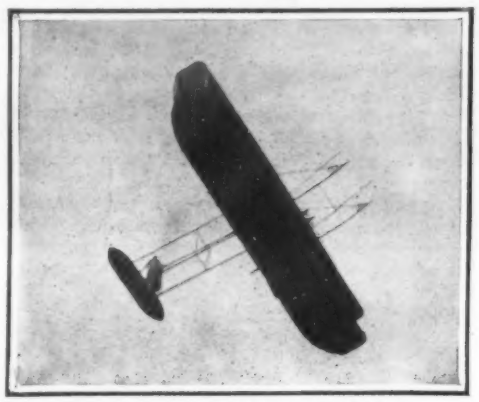
Mention was made in our last issue of the latest modification of the Wright biplane, and on this page we present to our readers illustrations of the appearance of the Wright machine with the double-surface horizontal rudder in front removed.

Some time ago it was found that by adding a tail the longitudinal stability of the Wright biplane was considerably increased, and soon after this tail was made to work in conjunction with the front horizontal rudder. This arrangement gave still better results, and of late the Wrights have found that they can dispense with the front rudder entirely, with a still greater improvement in the longitudinal stability of their machine. There appears to be less bobbing up and down of the aeroplane when flying in a stiff breeze with this new arrangement, which consists, as can be seen from the photographs, of simply leaving off the front rudder. The two small half-round fins, which, before, were placed between the planes of the front rudder, are now located in the framework of the skids near their front. These two fins are essential to the safe piloting of the machine in a strong breeze.

The rear part of the tail surface is warped slightly upward or downward, in order to steer the machine in a vertical plane. The arrangement is extremely simple, as can be seen from the photographs. The upward part of the tail is held rigid by suitable guides, while the rear half is warped by wires running upward and downward over pulleys and thence to the control lever at the pilot's left hand.

The principle of the new machine was explained in a note in last week's issue of the SCIENTIFIC AMERICAN. It can perhaps be understood to better advantage by using the simile of a steamer in a rough sea. The wake of the vessel is always smooth, despite the roughness of the surrounding water, and it is the bow of the vessel which receives the greatest pounding of the waves. In the same way with the aeroplane of the regular type, the forward rudder was struck by every gust of wind, which causes the biplane to pitch and dive. In order to steer the machine vertically, these planes are mounted far in advance of the main planes, where they will provide sufficient leverage to move the machine, and this very leverage, in the case of unsteady winds, proved a great disadvantage, as it makes the machine sensitive to the slightest puff of wind. In the wake of the aeroplane, as in the case of a vessel in water, there is a steady flow of air, and at this point the rudder can be placed to the most advantage. This fact has been recognized in monoplanes in which the elevating and direction rudders are placed at the rear of the machine. No gust can reach the rudders because it is flattened out by its passage through the main planes and literally ground up by the propellers. Our neighbor, the New York Times, in commenting on the note in last week's issue of the SCIENTIFIC AMERICAN, could not quite make out how a rudder at the rear of the machine could do effective work when the machine was diving. There appears to be a curious misapprehension among laymen that in order to prevent an aeroplane from pitching to the ground, there must be something in front to lift it up again to an even keel. As a matter of fact, there is no reason why the horizontal rudder at the rear of the machine should not do as effective work as the vertical rudders in the same place. The horizontal rudder serves to steer the machine up or down in exactly the same way, and with the same power, as the vertical rudders act to steer it laterally.

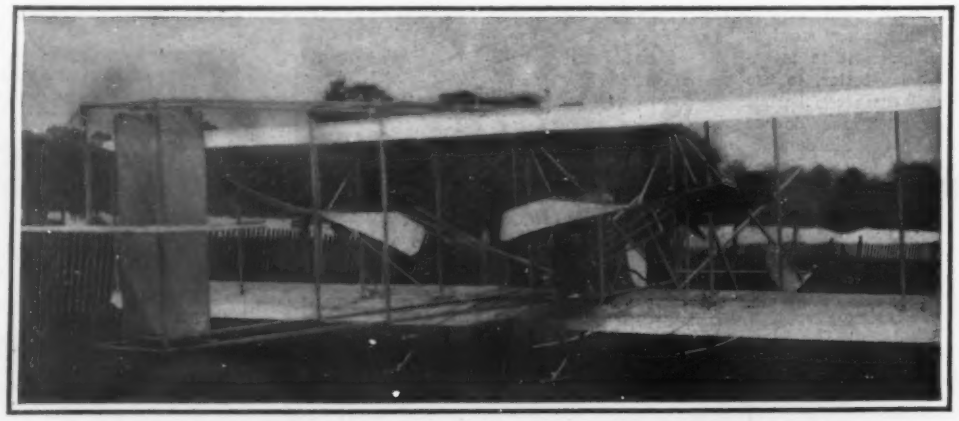
Our aeronautic editor saw some of the first flights made by the remodeled machine at Asbury Park two weeks ago, and he noted specially the greater stability in the fore and aft direction of the machine. He was also impressed with the dexterous control of their machines shown by the various Wright aviators, particularly Johnstone and Brookins, who suddenly tipped their machines at alarming angles of about 70 degrees with the horizontal in turning and made sudden descents and abrupt landings with accuracy. Winds of 25 miles an hour do not affect the machine seriously, and flights were made every day at Asbury Park, despite the fact that on some days a strong and puffy wind was experienced.



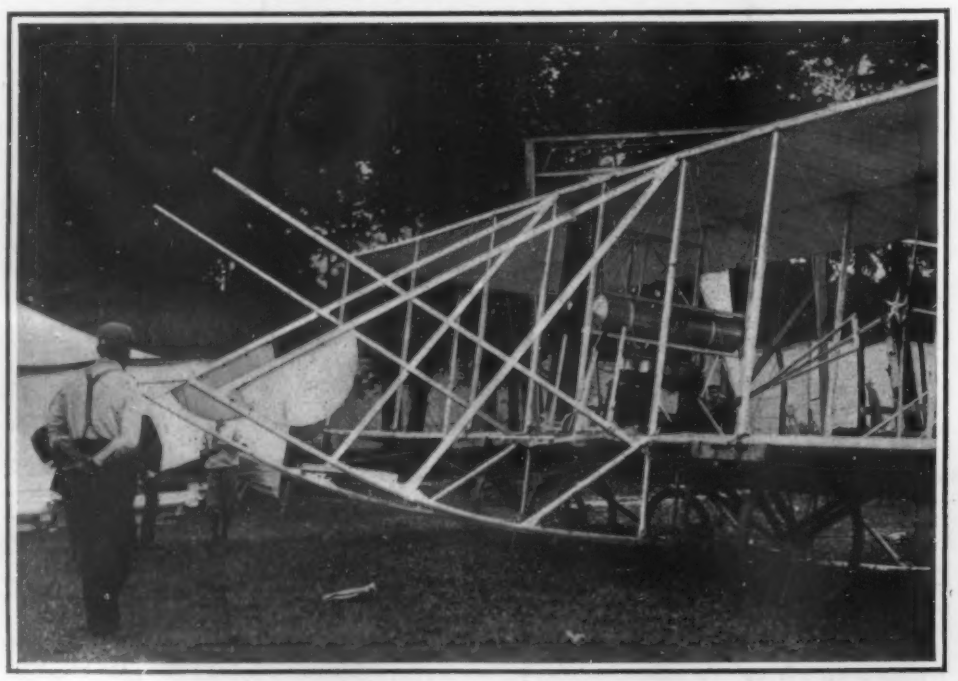
The new Wright biplane in flight.

In all probability the next improvement the Wright brothers will make in their machines will be some form of automatic stability device, which will insure the stability of their machines in the hands of the tyro. As it is now, the would-be pilot must go through a course of training in order to operate these machines; but when the knack comes to him, it is almost, if not quite, as easy as riding a bicycle.

The machine which was brought out at Asbury Park is a trifle smaller, and hence is faster than the regular machines. The length over all of the planes is 39 feet, and their width 5½ feet, with a standard 30 horsepower 4-cylinder Wright motor. This machine has shown itself to be quite a little faster than the regular one, but its chief difference lies in its enhanced stability.



The tail of the new Wright biplane, which serves as well as an elevating rudder.



The double elevating rudder has been removed from its supports in the new Wright biplane to secure greater steadiness in flight. The vertical surfaces formerly between the rudders are now carried on the skids.

THE NEW WRIGHT BIPLANE.

In German sporting circles Consul Thomas H. Norton, of Chemnitz, says interest is excited over the possibilities of a newly devised form of locomotion for use on water, termed the "hydrocycle."

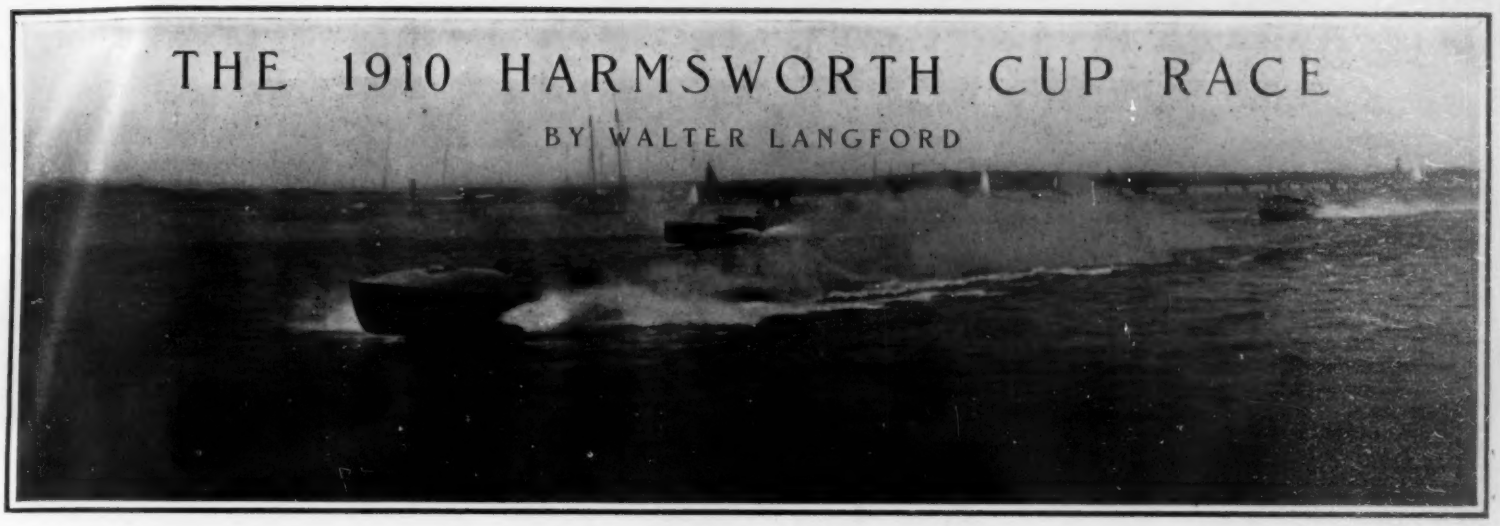
It is of exceedingly simple construction. A couple of parallel, pointed, water-tight tubes of galvanized iron, 10½ feet in length, are attached to each other 2½ feet apart. A light framework supports a seat. Beneath this is a pair of pedals, the motion of which is communicated to propeller blades. A handle bar in front of the seat is connected with a rudder. The traveler using this novel craft, by a pedal action identical with that of the ordinary bicycle, moves easily over the surface of the water, and alters his direction promptly at will. He has an advantage over the rower in facing forward, as does a canoe paddler.

The total weight of a one-seated hydrocycle is 66 pounds. The inventor, an Austrian (Herr Fr. Kaspar), attains a speed of six to seven miles per hour. The new craft offers an agreeable variation from ordinary rowing, for use on inland waters and along the seashore. More elaborate construction, provision for more than one passenger, and other improvements on the fundamental idea, may enable it to become a popular feature in marine sports, while there are certain practical elements of simplicity and cheapness in construction worthy of study.

Graphite and carborundum furnaces require variations of voltage of supply to allow for change of resistance as the temperature of the furnace varies. A new method, introduced by an electrical firm, for a 1,600-kilowatt, 25-alt., single-phase transformer, erected at the Acheson Graphite Company's works at Niagara, has recently been described in the columns of a contemporary. The transformer has a primary winding for 2,200 volts, while the secondary pressure can be varied from 40 to 200 volts—this range being obtained by taps on the primary and by a series parallel connection of the secondary. At 200 volts the current is 800 amperes, and at 40 volts it is 4,000 amperes, there being a smooth regulation between similar to that given by an induction regulator, but at better efficiency and power factor. A motor is employed to operate the 4,000-ampere switch. A dial switch disconnects the successive sections of the primary winding, and a compensator connects successively across two adjacent taps of the transformer, etc. All the switches, etc., are operated in proper sequence as described in the article, a diagram of connections being given to show how the various parts are connected up.

THE 1910 HARMSWORTH CUP RACE

BY WALTER LANGFORD



The start of the race.

The race for the British International Trophy, or the Harmsworth Trophy, as it is more popularly known, was won by the "Dixie II." because of a mishap which occurred to the British competitor, the Duke of Westminster's "Pioneer." The race was run over a triangular course off Larchmont, and was witnessed by many prominent yachtsmen and motor-boat enthusiasts from their yachts and other craft anchored near the starting line. A considerable number of spectators also viewed the race from the shore. Without in any way discrediting the achievement of the "Dixie II.," a performance which was characterized by wonderfully smooth and steady running, every motor-boat enthusiast must concede that the "Pioneer" is the faster boat. Indeed, it is generally admitted that the "Pioneer" is the fastest 12-meter motor-boat of our day. If she lost, it was largely due to American luck. The summary of the race is given in the table.

TIME TABLE OF THE RACE.

Start, 3:30 P. M., August 20th. Course 30 nautical miles.

Boat.	Owner.	1st Round	2d.	Finish.
"Dixie II."	F. K. Burnham	3:49:50	4:09:52	4:29:44
"Pioneer"	The Duke of Westminster	4:05:28	4:22:59	4:43:21
"Zigorella"	Daniel Hanbury	3:52:33	.....	.....
"Nameless"	Heckscher and Melville	.....	.....	.....

"Dixie's" average speed for the entire course: 30.08 nautical or 34.7 statute miles an hour.

THE CONTESTING BOATS.

The British challengers were three in number and various in type. The "Maple Leaf the Third," the original challenger, owned by Mackay Edgar, was practically broken in two during a try-out several days before the Harmsworth race in a heavy sea in Long Island Sound; hence she could not take part. Since she played no great rôle, an extended description of her seems unnecessary.

Some details of the boats will, no doubt, be of interest. The Duke of Westminster's new hydroplane "Pioneer" is 39 feet 11¾ inches in length with 7 feet beam. She is fitted with a 12-cylinder V-shaped Wolseley-Siddeley motor of 400 horse-power, which drives through a clutch and reverse gear a single screw. The engine is one of those which earlier in the year made a record in the Duke's fast boat "Ursula." The bore and stroke of this engine are 7¼ inches and 7½ inches respectively. The hull was constructed by Saunders of Cowes. It is planked with three skins of wood, fastened with copper wire, after the Saunders system. Its construction is very staunch and light.

The "Pioneer" has a flat-bottomed hull and is a true hydroplane. When at rest her stern is 9 inches below the water line, while her bow is about 6 inches above. When under way she rises to the surface at the stern, but her bow does not project out abnormally as in most hydroplanes. In other words, the angle with the horizontal of the bottom of the hull is much less than is usually the case. Nevertheless, she throws spray very decidedly, especially where there are any waves.

The other English hydroplane, the "Zigorella," is a sister boat to the "Miranda IV.," which was designed by Thornycroft. Her hull is 26 feet over all with a beam of 6 feet. She was the smallest boat in the race. The engine is an 8-cylinder V-shaped motor of 110 horse-power, having the cylinders cast in pairs. The bore and stroke are 4 inches and 7 inches respectively, and the valves are of large size, being 2¼ inches in diameter. The inner valves are arranged in the center of the cylinder heads, while the exhaust valves are in chambers at the side of the heads.

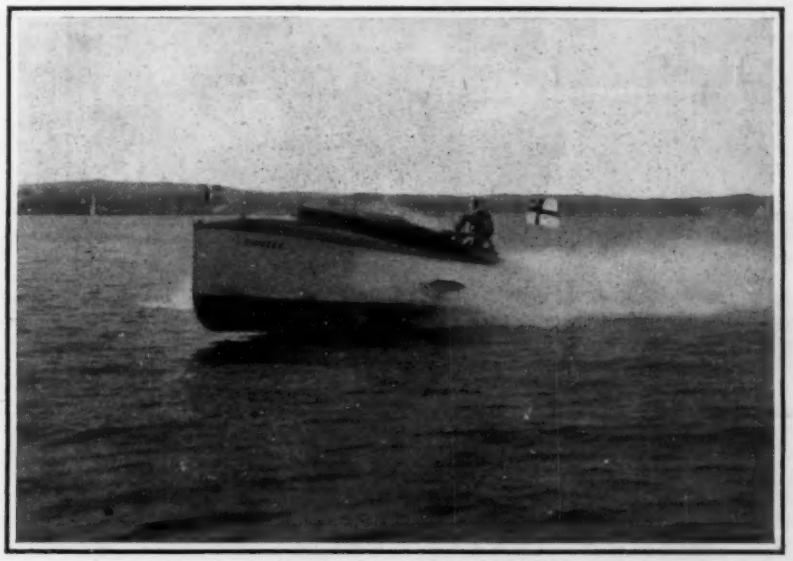
The "Dixie II." is 39 feet over all with a beam 5¼ feet. Her 8-cylinder motor is rated at 240 horse-power. We have already published a description of this boat and engine, both of which were designed by Mr. Crane, of New York. For this year's race the mufflers of her exhaust pipes had been so turned that the open funnel-shaped end was directed forward, a curved pipe out of the after end leading away the exhaust gases from the helmsman. The "Dixie I.," owned by E. J. Schroeder of the Motor Boat Club of America, won the Harmsworth Trophy in America in 1907. "Dixie II.," with the same motor she now carries, but with her original hull, successfully contended for the trophy in August, 1908. She defeated the British challengers "Wolseley-Siddeley" and "Daimler II." It was the wonderful reliability of the "Dixie II." that stood her in such good stead in the present contest.

The "Nameless," the only other American defender besides the "Dixie II.," is a long, clean-lined boat, 39 feet on deck, 38 feet on the water, 6 feet wide on deck, and 4 feet 10 inches at the water line. Her four propellers are driven by four 8-cylinder V-type motors, built by W. Herreshoff. Her thirty-two cylinders give one the impression that she is all engine. Across her slightly rounded transom, just below her name, are eight exhaust outlets.

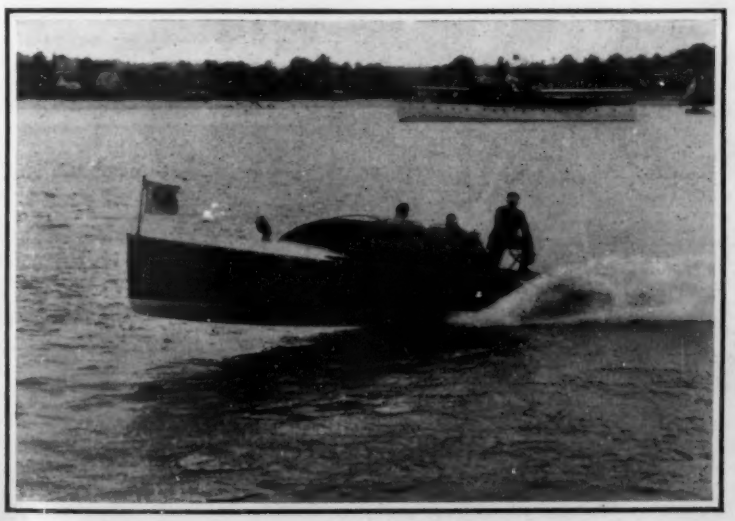
THE RACE.

The start of the race was set for 2:30 P. M., but it was not until

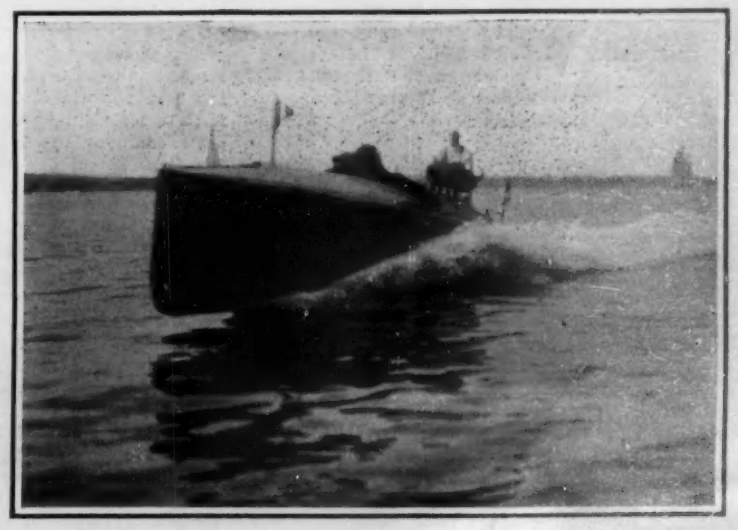
(*Continued on page 190.*)



The "Pioneer" traveling at full speed.



The "Nameless," whose engines have a total of 32 cylinders.



"Dixie II." turning the stake.

THE 1910 HARMSWORTH CUP RACE.

DEVELOPMENT OF THE ROTARY ENGINE

STEAM CONSUMPTION REDUCED TO 31.02 POUNDS PER HORSE-POWER PER HOUR

A promising feature in the revived attention which is being given to the rotary engine is the recognition by inventors and builders of the value of laboratory tests. The technical institutes throughout the country are well equipped for trying out steam and gas engines to determine accurately their horse-power and the steam or fuel consumption. The care with which these tests are made, and the reliable nature of the results, are recognized throughout the engineering world, and the reports of the tests are accepted as establishing, with great accuracy, the efficiency of any new type of engine.

Now the rotary engine is handicapped in the present attempt to develop it into an economical and serviceable prime mover, by its reputation, acquired in the early stages of its development, of being an extravagant consumer of steam, and of being subject to exceedingly rapid wear of its parts. To-day, however, the builder has at his disposal such high-class material and workmanship, that it has become possible to build a rotary engine which is equal, if not superior, in efficiency to reciprocating engines of the same power, and compares very well with them in durability. A considerable number of these interesting engines are being tried out at the laboratories of the various institutes, and the results obtained have justified the care and intelligence which are now being devoted to the problem.

In the Scientific American of June 4th, 1910, we illustrated and described at length a Herrick rotary engine which, in tests at Stevens Institute, developed 20.40 brake horse-power on a consumption of 44.4 pounds of steam per brake horse-power per hour. The accompanying engraving shows the larger of two rotary engines of the Harriman type, which at the Massachusetts Institute of Technology, have shown even better results. A diminutive compound rotary of 5.40 horse-power, the first of the type to be tested, showed a consumption of 41.34 pounds of steam per brake horse-power per hour. Later, a 25.72 horse-power rotary brought down the consumption to the remarkable figure of 31.02 pounds of steam per brake horse-power per hour—a record for engines of this type.

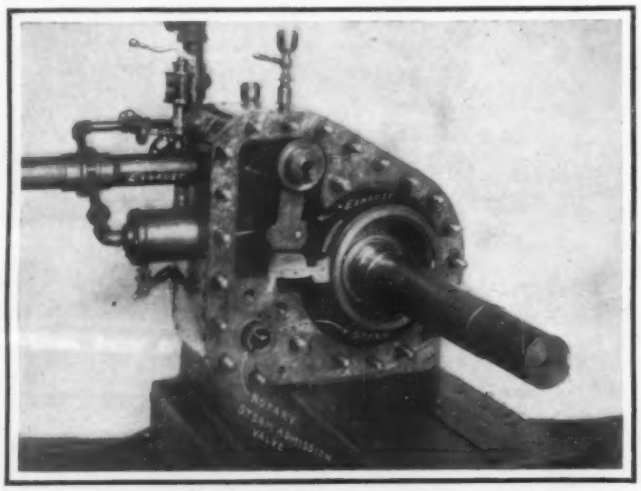
The smaller engine, which was of a purely experimental character, consists of two rotors, 4.7 inches in diameter, running in 6-inch cylindrical casings, the high-pressure rotor being 3.25 inches wide, and the low-pressure 6 inches wide. A small steam piston served to hold a rocking abutment in snug contact against the saddle and the rotor piston, for the purpose of preventing the steam from "short circuiting" to the exhaust. In this early type, steam is admitted by a reciprocating piston valve below the rocking abutment. The rotor, during the first third of its revolution, is acted upon by live steam. The steam is then cut off and the next third of the revolution is under expansion. During the last third the steam is under continued expansion in the low-pressure cylinder. There is thus a continuous steam pressure exerted on the rotor during the entire revolution.

In the test referred to, at the Massachusetts Institute of Technology, the following results were attained:

Condensing with Superheated Steam at Throttle.—Average gage pressure, 126 pounds; average temperature at throttle, 447 deg. F.; number of degrees of superheat, 93.7 deg. F.; average vacuum in condenser, 23.7 deg.; average load on brake arm, 17.39 pounds; average revolutions per minute, 564.7; total steam condensed per hour, 223 pounds; brake horse-power (Prony) 5.395; steam per brake horse-power hour, 41.34 pounds.

Encouraged by these results, a larger experimental engine of 20 estimated horse-power was built. The rotor, 9.4 inches in diameter and 8 inches long, revolves in a case 12 inches in diameter. The 4-inch shaft runs in 3¼-inch bearings which are 13 inches long. In a test made on January 12th of the present year at the Institute of Technology, the following results were obtained: The entering steam was superheated 3 deg. to dry out the moisture and the engine was run condensing under a gage pressure of 135 pounds per square inch. The brake horse-power developed was 25.72, and the consumption of steam per brake horse-power per hour reached the remarkably low figure of 31.02 pounds, the revolutions per minute being 498.4. In this engine the steam enters the cylinder through a rotary valve, which is run at one-half the revolutions per minute of the rotor.

As far as we know, this is a record in steam consumption for engines of this class, and it augurs well for the performance of a double engine of 125 horse-power of the same type, which is now being completed and will shortly be tested. Designs are being worked also out for engines of 2,000 horse-power, to work in connection with low-pressure turbines. These engines will have a large factor of safety at a weight of 40 pounds per horse-power, and they will be generally compounded so as to work the steam five or more expansions before it is delivered to the low-pressure turbine.



This engine, tested at the Massachusetts Institute of Technology, developed 25.72 horse-power and consumed only 31.02 pounds of steam per horse-power hour.

HIGHLY ECONOMICAL ROTARY ENGINE.

Harmon's Flight Across Long Island Sound.

On August 20th Clifford B. Harmon flew in his Farman biplane from Mineola, across Long Island Sound to Larchmont, and thence up the Sound to Greenwich, where he alighted near the property of his father-in-law, Mr. E. C. Benedict. Mr. Harmon has for some time been attempting to make this flight across the Sound, but not until the 20th ultimo did he find his motor working satisfactorily. After making a trial flight at Mineola with Mr. Charles K. Hamilton, he started across country about 6 P. M. His engine was equipped with pontoons, and his only protection in case he should land in the water was an inflated life belt.

After traversing about four miles above Long Island he flew out from Roslyn and directly across the Sound to Larchmont. He circled up over the club house, and thence headed directly up the Sound to Greenwich, some eight miles away. He experienced some difficulty in getting a suitable landing place, owing to the waning light, and damaged his machine rather badly in landing, but he made a very successful flight at the time when many people were able to witness it, in view of the large crowd that had assembled to see the motor-boat race. Mr. Harmon found it rather more difficult work to pilot his biplane above the water on account of a strong breeze that was blowing, which required close attention and considerable skill to make successful this first flight across Long Island Sound. The result of this flight was that Mr. Harmon won the handsome trophy offered by the proprietors of Country Life in America.

The passenger airship service, which was interrupted by the accident to the "Deutschland" last June, has been resumed in Baden-Baden. A daily service is to be maintained until September 30th. The trips are to last from one to three hours, with fares ranging from $25 to $75, depending upon the distance flown. The ship to be used is the "Zeppelin VI.," in which Zeppelin went from Friedrichshafen to Berlin when he visited the Kaiser.

The New York Times has applied for and obtained a sanction for its race from the National Council of the Aero Club of America, which is the governing aeronautical body in this country. As a consequence of this, the records made by various contestants for speed, distance covered without stops, mileage, etc., will be duly timed, chronicled and accepted the world over as official records. In this connection, we wish to draw attention to the fact that contestants for this race have an opportunity to win at the same time, the Scientific American trophy for the longest continuous flight during the year 1910. The only formality that is necessary is that the entrant send a letter to the Aero Club of America, giving them official notice that he is making this long-distance flight on October 8th. By the rules of the contest, the Aero Club of America cannot recognize the contestant in the Chicago Times race as a contestant also for the Scientific American trophy unless an official notification that they wish to try for the trophy is sent to them by the individual entrants.

The Pulsating or Living Nuts of Tropical America.

BY L. LODIAN.

Living nuts were described over half a century ago in an old Paris magazine, La Revue de Zoologie ("Observations sur une nouvelle espéce de Carpokapsa"); and received the official name of *Carpokapsa saltitans*. (Popularly known also as "electric nuts," "magnetic nuts," "jumping nuts," etc.)

Its generic relations are defined as follows: This insect belongs to the family of comparatively small moths, the larvæ of which are mainly "leaf rollers." Its generic relations are of particular interest in that it pertains to the same genus with the codling moth, *Carpokapsa pomonela*.

The nuts are about four-tenths of an inch long, and of about the same width, smooth on the outer surface, bisected by lines which show them to be two-valved, and of a form indicating that they had been united in a globular three-celled ovary. In shape they are subtriangular, their two inner sides plain, and meeting at an obtuse angle, and the outer side rounded.

The ordinary "jumps" of the *Carpokapsa saltitans* are successive jerky movements of about one-eighth of an inch in length, repeated at intervals of a second or two. At times, however, they are more violent—capsizing the nut from one of its flat sides to its concave surface, spinning it around upon one end, or projecting it with an irregular rolling motion, to a distance of an inch or more.

Placed upon a small table, in a few minutes several will have thrown themselves over its edges upon the floor. If confined in a closed box, they in a short time become quiet, and no sound is heard from them; but upon opening them and exposing to the light, the motions are at once moderately resumed. If further disturbed by being turned out upon a table or into the hand, their more violent motions soon commence, and continue for a long time. Left on the floor of a room overnight, their audible movements in the stillness somewhat resemble the disturbing gnawing of mice, and the nuts will have almost disappeared by daylight, contriving to work themselves into nooks and corners.

Their peculiar movements are said to be produced by the larva holding fast to the silk lining of the nut with its three hinder pairs of strongly-hooked abdominal legs; and in this position, with the anterior portion of its body curved upward, violently tapping the walls with its head, sometimes thrown from side to side, but more often brought directly down.

The emergence of the moth from the nut is from the lower end of the outer surface, nearly opposite to the scar of the inner surfaces. Examination of the lid of the aperture through which the insect has effected its escape, will show that it consists only of the outer wall of the seed—the inner wall and the white connecting material between the two having been bored through or eaten away.

There are other "jumping nuts," as the *Euforbia*, also of tropical America, containing a tiny hymenopterous insect; a *Tamarix*, of tropical Africa; and yet another, the seed of which is unknown by name.

The ingenuity of an American inventor named Sandell has been applied to the elaboration of a complicated apparatus for "playing" a violin from a perforated music roll, which is referred to in Electrical Engineering. A group of 60 fingering magnets take the place of the performer's left hand, and the bow is represented by a set of four revolving disks ¾ inch in diameter, each made up of a bundle of 50 flexible celluloid washers. One of these disks acts on each string, and electromagnetic devices controlled by contacts governed by the perforation of the roll produce expression by varying the speed of the disks and their pressure on the strings, and a special magnet provides a bouncing bow action when required. There is also a set of four magnets for pizzicato effects, while a vibrato effect is obtained by the action of a large magnet with a weighted armature arranged to shake the tail piece sideways. The same roll actuates the contacts of electrical piano player movement in the same case, which provides the accompaniments. The apparatus is stated to take about half an ampére at 110 volts.

MAGIC FOR AMATEURS—VIII

RING TRICKS

BY W. H. RADCLIFFE

NO. 18. CHINESE WONDER RINGS.

Eight light iron wire rings about six inches in diameter and three-sixteenths of an inch thick are used in one of the ring tricks about to be described. Rings commonly employed on drifting shad-nets serve well for the purpose. One of these rings *a*, Fig. 26, must be cut open, but the ring should be bent so that the springiness of the iron keeps the ends evenly together when they are not pulled apart. Two rings, *c* and *e*,

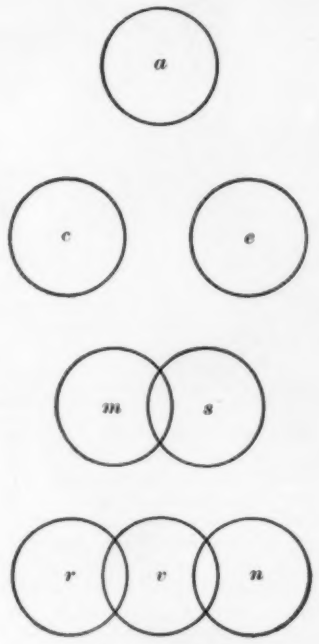


Fig. 26.—EIGHT RINGS FOR MAKING CURIOUS TRANSFORMATIONS.

are left separate, but the rings *m* and *s* and the three rings *r*, *v* and *n*, must be linked and soldered together as shown.

In presenting this trick the performer comes forward with the rings arranged in the following order: *c*, *e*; *m* and *s*; *a*; *r*, *v* and *n*. He hands out the rings *c* and *e* as samples, saying they are all alike—solid, round and hard.

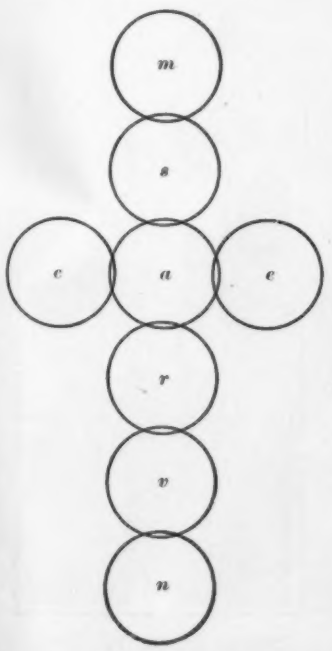


Fig. 27.—THE CHINESE CROSS; ONE OF THE FIGURES INSTANTLY FORMED BY THE EIGHT RINGS.

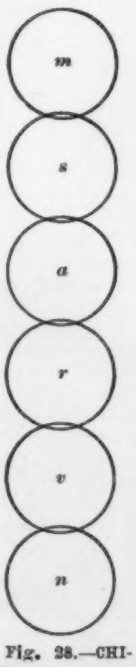


Fig. 28.—CHINESE TAIL INSTANTLY FORMED BY RINGS.

After the two rings have been examined he asks one of the spectators to link them together. After one or two unsuccessful attempts it will undoubtedly be given up by the experimenter as impossible. The performer, however, asserts that it is perfectly easy, and to prove it, takes the rings *m* and *s*, one in each hand, and holding them at first so that they appear separate, brings them together, apparently rubbing or pressing the one into the other. He then hands them to the doubting one to be examined.

As the reader is already aware, these two rings were previously welded together. The spectators will probably advance an argument along these lines, and to upset it the performer takes up the ring *a* from the others he has meanwhile kept well out of reach of the audience and asks for the ring *c* or *e*, saying he will link them together as he did the rings *m* and *s*. The ring *a* being cut, it is easy to link either *c* or *e* into *a*. It should be done slowly under cover of the fingers, but in full view of the audience. If the ring *a* be picked up at the cut, the apparent pressing of the

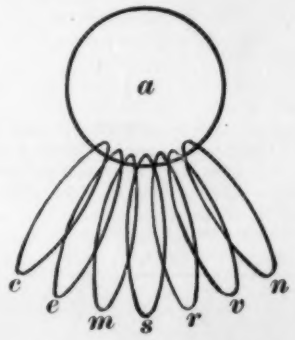


Fig. 29.—ALL RINGS APPEAR TO BE LOCKED TOGETHER.

rings together can be done neatly and without detection. The second single ring is now linked like the first into the ring *a*, then the ring *r*, and opposite *r*, with respect to the rings *c* and *e*, the ring *s* is linked into *a*. Taking the ring *m* between the teeth, the ring *c* in one hand and the ring *e* in the other, the performer constructs the Chinese cross, Fig. 27. Releasing the left hand, he grasps the ring *a* at the cut, unlinks the rings *c* and *e*, and shows a straight chain or Chinese tail, Fig. 28. Again gaining possession of the ring *a* at the cut, all the rings not already linked into *a* are slipped through the cut as previously described, and the Chinese-what-is-it, Fig. 29, is formed. In exhibiting this last figure the ring *a* is turned so that the cut is at the top; the cut then can be naturally and effectively hidden by the first joint in the first finger of the left hand when extended to hold the bunch of rings to view. While showing the figures in which the cut in the ring *a* cannot be hidden by the fingers, it is advisable to keep the figure in motion by swinging it back and forth, because in this way the spectators are less liable to notice the deceptive part.

NO. 19. THE MESMERIZED STAND.

To be able to raise stands, chairs, baskets, and other light articles by the laying-on of hands, in the minds of some persons, is an evidence of superhuman power.

Fig. 30.—THE SECRET OF MANY LEVITATION TRICKS IS IN PERFORMER'S RING.

All that any one requires in order to do this is a thin band ring slightly flattened on one side and having a narrow slot cut or filed into it at this part. A fancy brass ring costing but a few cents and of a size to fit the middle finger of the right hand serves well. The slot should be made in it as shown at *a*, Fig. 30, with a fine saw or file.

A wire nail *s*, just thick enough to slip easily into the slot and having a head which will not pass through, is driven into the center of the top *n* of the article it is desired to mesmerize. Light articles, preferably willow or rattan stands covered on top with plush or similar material so as to detract from the nail, are especially desirable. The body of the nail in each of these should project about one-sixteenth of an inch above the solid part.

The presentation of the trick is easy. Slip the ring, slot side outward, on the middle finger of the right hand, and turn it so that the slot is on the palm side before facing the audience. Inform the spectators that you are about to mesmerize the article before you, referring to whatever has been prepared in advance.

Turn the article about so that the audience can see all sides and the top. If it is not held too near the spectators and is kept moving, the small nail will not be noticed. Then place it in front and lay both hands, palms downward, upon the top surface, moving them slowly back and forth until the wire nail is felt to slip into the slot in the ring; slowly raise the article, keeping both hands flat upon its surface. If the piece is light in weight, it can readily be swung around and over the head. It is advisable to use but one hand after the article has been raised and given a few swings with both hands, because this leaves an impression that either of the hands could be removed at will. In concluding the performance return the left hand to the top of the article before lowering it, and after the piece has been placed upon the floor withdraw both hands from its surface simultaneously.

The Forthcoming Meeting of the International Meteorological Committee.

The International Meteorological Committee, all of whose members are directors of the National Weather Bureaus, will hold its next triennial meeting at the Royal Prussian Meteorological Institute, Berlin, beginning September 26th, under the presidency of Dr. W. N. Shaw, F.R.S., director of the English Meteorological Office.

The provisional programme, already drawn up, indicates that the number of important topics to be discussed will be unusually large. These include: Köppen's suggested reforms in the units of measurement used in meteorology; the report of the Commission on Maritime Weather Signals, which met last year in London and prepared an international code of storm signals, with which it is proposed to replace the twenty or more different systems now in use in various countries; the report of the commission charged with the preparation of new isothermal charts for the globe; the report of the commission that is endeavoring to organize a "réseau mondial" (an international exchange of weather reports by post and telegraph, so that each country can keep *au courant* of weather changes in other parts of the world); besides the reports of several other special commissions and a number of interesting proposals from meteorological services and individuals.

The United States Weather Bureau has proposed seven topics for discussion, including the question of inaugurating the systematic study, by spectroscopic methods, of the amount of ozone in the atmosphere, as it is now believed that this substance plays an important rôle in absorbing solar radiation. The Weather Bureau also suggests the appointment of an international commission on meteorological terminology, in order to secure uniformity in use of the technical vocabulary of the science.

Four new members of the International Committee have recently been elected, by correspondence, viz.: Dr. E. van Everdingen, director of the Royal Netherlands Meteorological Institute, De Bilt; Capt. C. H. Ryder, director of the Danish Meteorological Institute, Copenhagen; Prof. Dr. W. Trabert, director of the Central Institute for Meteorology and Geophysics, Vienna; and Dr. Gilbert T. Walker, director-general of Indian observatories, Simla.

The International Commission for Terrestrial Magnetism and Atmospheric Electricity, of which Dr. L. A. Bauer and Prof. T. C. Mendenhall are the American members, will meet in Berlin a few days before the meeting of the International Meteorological Committee.

On Sunday, September 25th, the members of both these organizations will make an excursion to Potsdam and Seddin, to inspect the meteorological and magnetic observatories.

Some interesting developments, states the Railway Club Journal, have followed upon the introduction of the through District trains from Ealing to Southend. The train is now made up of ten vehicles (eight vehicles of the six-wheel type and two four-wheeled brake thirds), and on several occasions an extra six-wheeler has been added. It now leaves Ealing two minutes later, but is booked to arrive at Little Ilford sidings at its previous time. Through trips have been made during the last month by special parties from Putney Bridge, South Harrow, and Richmond to Southend, and there is no doubt that the service offers many advantages and attractions to residents on the western lines of the District Railway.

CURIOSITIES OF SCIENCE AND INVENTION

FURNACE FOR INCINERATING REFUSE.

One of the most perplexing problems of sanitation is the disposal of refuse of all kinds, in places where sewerage is not available. Numerous systems, such as filtration, chemical dissolution, cesspools, etc., have been tried out extensively with but problematical results, and the undisputed fact remains that fire is

FURNACE FOR INCINERATING REFUSE.

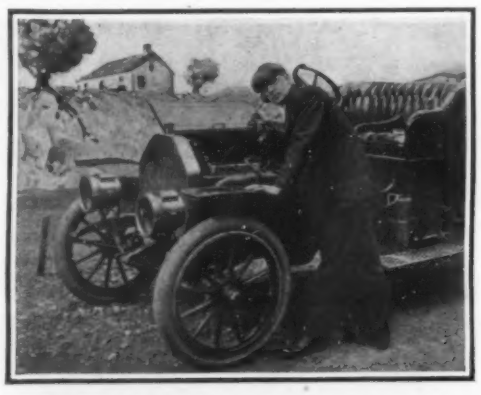
the only reliable agent for the complete and sanitary destruction of all waste matter. The accompanying engraving illustrates a device that has been adopted by the United States government for use in army camps. The illustration shows the device partly broken away, so that the interior construction may be understood. The device consists in reality of a furnace, in which is placed a large cast iron container, adapted to receive the waste which is here cremated. By this system no odors are allowed to escape during the process of incineration. The arrows show the course of the draft through the incinerator. The furnace consists of a sheet steel shell, with an outside jacket, and the necessary draft is admitted through the space between the jacket and the shell. The gases from the container are drawn by the draft down through a pipe at one side of the incinerator, and fed to the bottom of the grate; thence they pass through the fire, aiding in maintaining combustion, while any noxious products that may be present are consumed. After passing through the fire the gases thus purified are taken into the stack and out to the atmosphere. The furnace is thus disinfected automatically, and it always remains fresh and clean for the next incineration of refuse.

NOVEL TYPE OF WIND MOTOR.

An inventor in Philadelphia has been experimenting with wind motors of a peculiar type. As shown in the photographs, the motor consists of a series of wings formed with movable blades or shutters so arranged that when the wings are in their lower position the blades are closed, and when the wings are moved to their upper position the blades are opened. Thus, there is no resistance offered by the wings when moving against the wind. The turning of the blades is due to the fact that they are eccentrically mounted, and their weight brings them into the open or closed position. The motor is here shown mounted on a short tower. In practice it should be placed on a tall windmill tower or building so that the upper currents of air may strike it. Like the ordinary windmill the motor is mounted to swivel freely and is provided with a vane, as shown, which keeps it properly directed to the wind. Power from the motor is transmitted by chain and sprocket gearing to a horizontal shaft below, and thence it is transmitted by bevel gearing to a vertical shaft on which the motor is mounted to swivel.

DEVICE FOR LOCATING TROUBLE IN AN ENGINE.

When a pounding or tapping noise is heard in an engine it indicates trouble, and the experienced engineer knows that it is necessary for him to locate the trouble before serious damage results. The question of locating the trouble, however, is not an easy one. Frequently an engine is entirely dismantled without revealing the cause of the knocking, and when reassembled, the tapping noise is still there. In order to simplify the task of locating the difficulty, the device illustrated in the accompanying engraving has been provided. It consists of a receiver, somewhat similar to a telephone receiver, provided with a very sensitive diaphragm, to which is directly connected a long rod. The rod is made up of several sections, which may be disconnected to permit of folding the instrument into a small compass. By placing the end of the test rod against different parts of the machine and applying the ear to the receiver, one is able to locate very exactly the point from

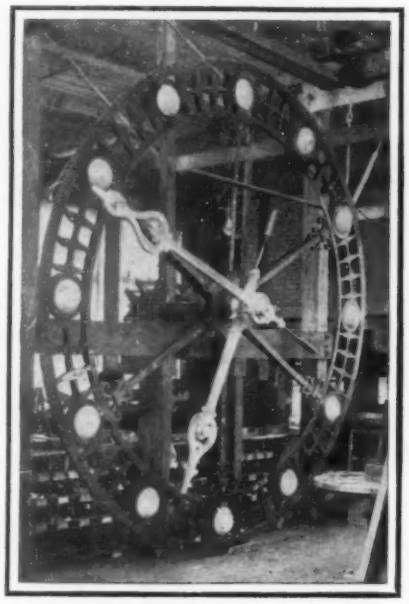


LOCATING TROUBLE IN AN ENGINE WITH AN INSTRUMENT LIKE A STETHOSCOPE.

which the sound is issuing. Having this information to start with, no unnecessary parts need be removed, and much time may be saved in locating the trouble.

A REVOLVING CLOCK DIAL.

Something that is decidedly new in clock construction has been built for the United States Post Office, Court House, and Custom House at Newbern, N. C. The novelty consists in arranging the clock dials so that they may be revolved to provide access to the electric lamps which mark the hours. The clock has four dials, one of which is shown in the workshop in the accompanying illustration. Instead of bearing numerals to indicate the hours, there are opalescent glass disks which show white in the daytime. At night electric lamps are lighted behind each disk, so as to illuminate them. Behind each dial in the building there is a window, through which access may be had to the lamps, and it is for the



A REVOLVING CLOCK DIAL.

purpose of bringing the lamps within reach of the window that each dial is mounted to rotate. The hands, which are made of cast aluminium, carry an electric light at the hub and also at the point. The lamps are red, so as to distinguish them from the dial lamps. The clock machinery is made very powerful, to carry the great weight of the hands, with the wiring and lights attached.

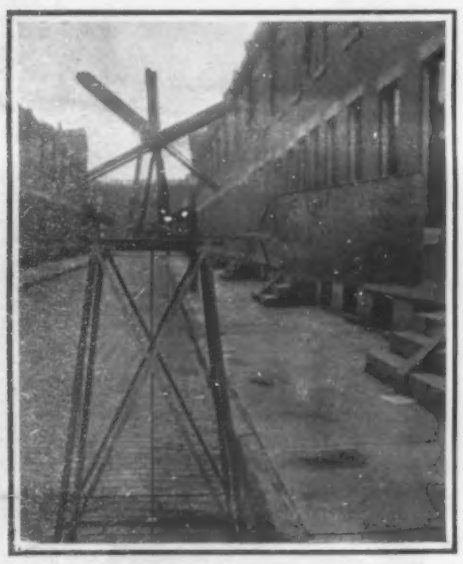
CABLE TESTING BY INDUCTION.

A novel method of testing cables has recently been introduced. It consists in sending through the wire an alternating current of high frequency, which is produced inductively and without any direct contact with the wire. A tester then follows the cable with a receiving apparatus, which consists of a coil mounted on a bamboo rod and connected to a head phone receiver. The receiving coil is so wound as to transmit only the electric waves sent out by the sending apparatus. These are recognized by the musical tone produced in the tester's telephone. It is only necessary to place the coil against the sheath of a cable, when the tone will be distinctly heard. As soon as a fault is passed, the tone stops. Troubles from wet cables are as easily found as other faults. So effective is this apparatus, that it has been possible to locate a fused wire in a cable to within half an inch of the point of fusion.

TESTING CABLES BY INDUCTION.

FRENCH PROPELLER-DRIVEN BICYCLE.

With a view to securing exact data for a pedal-driven aeroplane with which he has been experimenting, Marius Michel, in France, equipped an ordinary bicycle with an aerial propeller, as shown in the illustration. Instead of the drive being taken to the rear wheel, it is transmitted by chain to an intermediate sprocket just back of the bicycle head, and



WIND MOTOR OF PECULIAR PADDLE-WHEEL TYPE.

FACE VIEW SHOWING THE THREE SETS OF WINGS.

by a second chain to bevel gears driving the propeller shaft.

Trials on a track and on the level road have shown that the propeller-driven bicycle was superior in speed to one with chain drive to the rear wheel. This, however, had already been proved by the experiments made with motorcycles several years ago by Ernest Archdeacon, Anzani and the late Captain Ferber, all notable aeroplanists. Since then, progress has been made in propeller design and construction and much

PROPELLER FOR A GLIDER, TESTED ON A BICYCLE.

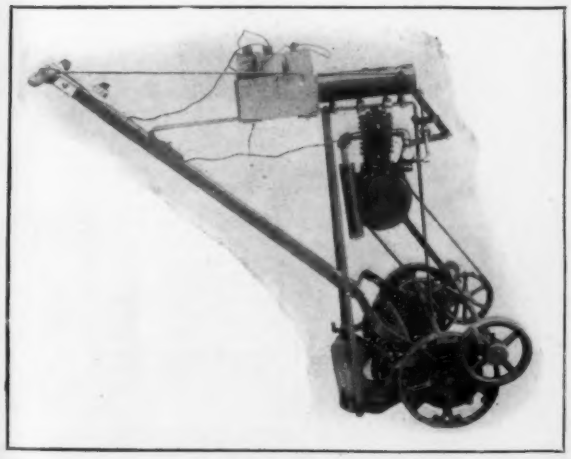
higher relative efficiency has been obtained by Michel with his one-man power than was secured by Anzani with his twin-cylinder racing motorcycle.

Having discovered by practical experiments the most efficient form of propeller and the most satisfactory gear ratios, Marius Michel is having these fitted to a propeller-driven glider. It is not expected that anyone will be able to make prolonged flights with this, but that the addition of the pedal-driven propeller will lengthen the gliding flights over suitable hillsides.

Although of no practical utility in itself, the propeller-driven bicycle offers interest as a machine for use on racetracks, for it will afford a new form of competition against the ordinary type of bicycle and an opportunity for the exercise of the skill of the designer and constructor of the propeller.

MOTOR-DRIVEN LAWN-MOWER.

A Pennsylvanian inventor has recently come to the aid of the long-suffering suburbanite with a lawn-mower which is self-propelled, and needs but to be guided over the turf. The motor attachment may be mounted to a lawn-mower of standard make, and consists of a framework secured to the handle of the mower and to the brackets in which the rear roller is mounted. Suspended from the framework is a gasoline motor that is connected with chain and sprocket gearing to a pinion which drives the gear mounted on the main shaft of the mower. The gasoline tank is supported above the mower, as is also the electric battery which operates the ignition. Placed within convenient reach of the mower handle is a lever by which the engine may be controlled, and a button switch for closing or opening the battery circuit. The driving mechanism is mounted in



MOTOR-DRIVEN LAWN-MOWER.

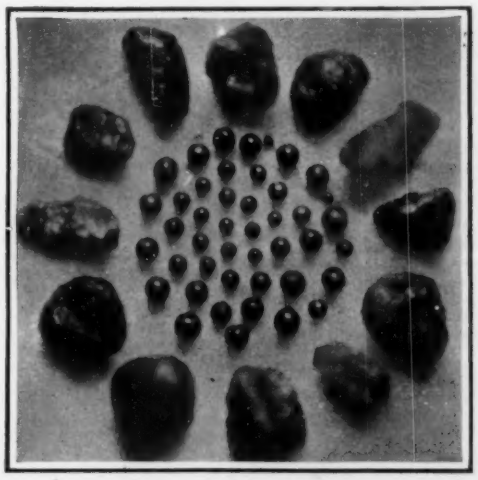
such a position as to preserve the proper balance of the machine. With a mower thus equipped the tedium of cutting the lawn is entirely overcome, and the work is greatly expedited. The machine should be particularly valuable for use on a large estate, as it will operate more quickly, and hence cover a much larger area, than the common type of lawn-mower.

METEORIC DUST.

BY F. T. AMAN.

The group of shot-like pellets arranged in the middle of the accompanying illustration are minute hollow spheres of steel known as meteoric dust; they are infinitely finer than grains of sand, a few of which have been placed around the group for the purpose of showing their comparative size. The whole is magnified 900 time or 30 diameters, and could be placed inside a circle one-tenth of an inch in diameter.

Their origin is interesting. Meteors or shooting stars, as they are generally called, have from the beginning of things been bombarding the world at a rate estimated by the highest authority at many thousands an hour. Fortunately, owing to our protecting envelope of air, very few of these missiles reach us. In size meteors vary from a few ounces to many pounds in weight, and it is only very occasionally that one is of sufficient dimensions to survive the passage of 80 to 100 miles through an atmosphere increasing in density as the earth is approached. The speed at which they enter the atmosphere, calculated at not less than 35 miles a second, generates such intense heat by friction, that the iron of which the meteor principally consists is immediately reduced to an incandescent vapor, which is the luminous train so frequently seen in the heavens on a clear night. The vapor rapidly cools and condenses in the form of these minute particles, which assume the spherical form, as does shot during its fall from the top of the tower. Finally, the little spheres are scattered by the winds and currents in the upper regions, and gradually descend in their millions as an invisible but never-ending shower.



METEORIC DUST AND GRAINS OF ORDINARY SEASHORE SAND; MAGNIFIED 30 DIAMETERS.

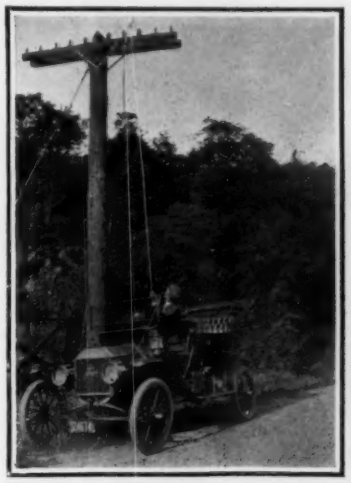
The perfect condition in which the spheres are found is due to the presence of certain non-corrosive elements found by analysis to be present in the metal of meteors which have come to earth.

These little spheres will be found in almost any sample of dust, particularly where such has collected in sheltered recesses or hollows, as in the gutter on the housetop, or round the roots of old trees and dry ditches. They may be readily gathered by a magnet, and when mounted form an interesting object for the microscope.

TELEPHONE CONNECTION FOR AUTOMOBILISTS.

BY CHARLES A. HARTLEY.

By means of the simple device here illustrated automobilists who get into trouble or meet with an accident can have telephone connection from any point in the rural districts where there are overhead telephone wires, within two minutes, without leaving the car. The device is also useful to officers in pursuit of criminals. It is composed of a hand microphone and cord. The cord and attachments are lifted to the wires above by means of a jointed aluminium rod, which is packed away in small compass when not in use. The clip with which the connection is made consists of two strips of metal riveted together at the bottom and formed with slots about the size of an ordinary wire. These strips open slightly at the top for the purpose of receiving the telephone wire. When pressed upward by the aluminium rod with the telephone cord attached, the wire drops into the slot and the metal clip closes on it, sustaining quite a considerable weight. When through talking the automobilist detaches the connection by a slight jerk forward or backward. The moment the cord is pulled on at a sharp angle with the wire, the clip is pressed open and the attachment drops to the ground.



MAKING A TEMPORARY TELEPHONE CONNECTION.

CONVERSING BY 'PHONE FROM AN AUTOMOBILE.

ALLIGATOR SHOOTING THE CHUTES.

The very last creature that the average man would select as a trick animal is the huge sluggish reptile shown in this picture; yet even that deliberate brute can sometimes hit a swift pace. It has even been trained to shoot the chutes with easy grace, as the accompanying photograph testifies.

This feat is performed regularly at an alligator farm in California, the big saurian waddling up the incline at the other side and sliding down the watery chute at express train speed.

At this novel farm there are five hundred or more specimens, ranging in size from the huge bull to the newly hatched, lizard-like youngsters. They are raised for their hides, although the sale of little fellows for "pets" and the admission to the grounds help swell the profits of this unusual business.

The Pan-American Congress which met at Buenos Ayres unanimously approved of a convention on patents. If the idea is carried out, a patent in one of the signatory States will have the same protection in other American republics.

ALLIGATOR SHOOTING THE CHUTES.

RECENTLY PATENTED INVENTIONS.

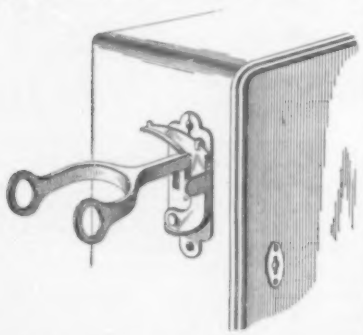
Pertaining to Apparel.

ARTIFICIAL FEATHER.—M. VEIT, New York, N. Y. This feather forms plumes, aigrets and other ornaments, such as are used for hat and dress trimmings, millinery and hair ornaments, and the like, the feather being formed from a blank having a back, and overlapping sheets secured thereon, and from which blank are cut thin strips, each having a stem and filaments extending therefrom.

Electrical Devices.

SWITCH FOR ELECTRIC-LIGHT SOCKETS.—C. D. GERVIN, New York, N. Y. This switch is arranged to permit convenient manipulating of the switch for lighting and extinguishing purposes or successively pulling a flexible, depending, actuating means connected with the operating lever of the switch. For this purpose oppositely-disposed fixed contact plates are adapted to be engaged and disengaged by terminals of a switch arm held on a shaft provided with a spring-pressed ratchet lever, capable of turning on the shaft in the reverse direction by action of its swing.

TELEPHONE NOISE-EXCLUDER AND CURRENT-SAVING DEVICE.—WILLIAM E. BURT, Yuba, Wis. Telephones are usually designed so that the battery circuit is completely broken by the action of the receiver hook before the breaking of the talking circuit. If, then, the receiver hook is gradually pulled down, it will



ATTACHMENT FOR TELEPHONE RECEIVER HOOKS.

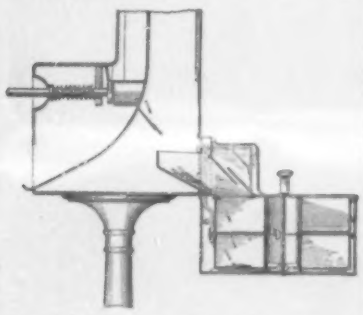
reach a point where the battery circuit is broken and one can hear but cannot be heard over the line. If the receiver hook is fully opened, the transmitter picks up local noises which are heard by the operator in the receiver. Mr. Burt's invention consists of an attachment for the telephone which is designed to hold the receiver hook at a point at which the battery circuit is broken and the talking circuit is completed.

Of Interest to Farmers.

FEEDER FOR THRESHING-MACHINES.—J. S. WALCH, Walla Walla, Wash. In this device the threshing of stacked loose grain or with grain in bundles in the field is accomplished with less difficulty than with the ordinary machine. It may be used in connection with a threshing machine to feed the grain uniformly in the cylinder of the machine, thereby preventing clogging of the latter and annoyance and inconvenience resulting therefrom.

Of General Interest.

TRANSFERRING CASE FOR VALUABLES.—ARTHUR POWELL, Box 736, Stratford, Conn. The invention consists of a case adapted for use in connection with vending machines for the purpose of enabling the collector to pass from one vending machine to another collecting the coins therein contained, and yet keep

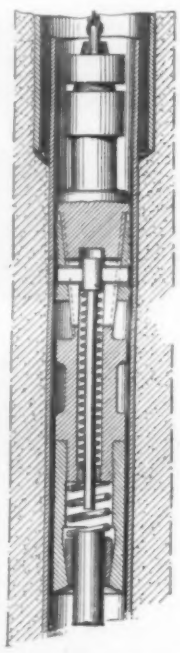


TRANSFERRING CASE FOR VALUABLES.

the contents of the respective machines separate. The various collections from the various vending machines may afterward be identified and counted, permitting one to form an estimate of the earning powers of the respective machines.

DISPLAY APPARATUS.—M. L. STERN, New York, N. Y. This invention pertains to apparatus for displaying merchandise in shops, show windows or other places of this character, and relates more particularly to display apparatus comprising a support having resilient parts, hangers depending from these parts and having removable connection therewith, and a shelf secured to said hangers, the shelf carrying the merchandise or other articles to be displayed.

TOOL-FISHING APPARATUS.—A. C. GRAHAM, Oildfields, Cal. The object of the invention is to provide an apparatus arranged to insure an automatic release to the gripping jaws by the action of the tool to be fished out. The gripping device on the carrier is held by



TOOL FISHING APPARATUS.

fragile, frangible means, in inoperative position, and a releasing means is connected with the gripping device. This is adapted to be operated by the tool to be fished for, to release the gripping device.

CONCRETE POST.—W. W. WALTHER, Booneville, Mo. An object of the inventor is to provide a post having a reinforcing member and an attachment adapted to be secured thereto, for fastening wires. A further object is to provide a fastening device by means of which the wires carried by the posts may be secured without the use of nails or staples.

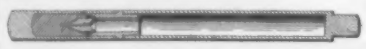
STAMP AFFIXER.—M. E. HARWELL, De Kalb, Texas. The device here illustrated provides a novel means for moistening the stamps as they are fed from the roll to be applied to the envelopes. The device consists of a water

IMPROVED STAMP AFFIXER.

reservoir which is completely inclosed except for an opening at the forward end into which a wick is fitted. The stamp roll is mounted in bearings carried by the reservoir. The stamps are guided by means of side rails so that they come in contact with the wick and are moistened ready to be applied to the envelope.

WATER-WHEEL.—T. A. MACDONALD, Clifton, N. J. This invention is an improvement on that disclosed in a prior patent granted to Mr. Macdonald, in which he showed a wheel adapted to be anchored in a stream whereby the force of the current of the stream might be utilized to drive machinery of any description. The present invention likewise has for its purpose the provision of a wheel for similar use which, however, is formed so as to have an increased efficiency without adding to the cost of construction.

FOUNTAIN PEN.—DR. R. N. SAHA, of Luchmikunda, Benares, India. The pen is of the type known as a stylographic pen. An important feature of the invention consists in the provision of two air vents situated within the annular groove at the end of the writing section, as shown in the illustration. By this means the long air tube with the delicate fixed



IMPROVED STYLOGRAPHIC PEN.

or drop needle feed of the common stylographic pen is avoided. The air vents permit the ink to flow smoothly to the last drop. The pen is especially adapted for making good carbon copies.

DRUM WITH LOADING AND DISCHARGING APPARATUS.—A. J. DINKEL, Clarinda, Iowa. This invention relates to a drum for mixing or separating various kinds of material, such as sand, grain, cement, or gravel, and particularly relates to the loading and discharging apparatus combined therewith. It provides a simple scoop-elevator for a drum with suitable means for feeding the material to the scoop-elevator at the proper point.

RATE AND QUOTATION SHEET.—B. E. ALLISON, Kansas City, Mo. This invention is for use in commercial enterprises dealing with the sale of merchandise, which serves as a record of price quotations on merchandise to customers or purchasers at various receiving points, the quotations depending upon railroad rates to the receiving points from shipping points, which afford a record of past quotations and constitutes a reference regarding ratings, etc., of the purchasers.

Hardware and Tools.

CARPENTER'S-BENCH PLUG OR STOP.—G. F. ZAUN, Delta, Colo. More particularly this invention is an improvement in plugs which are formed of two bars or arms pivoted together about the middle of their length and one of them provided at one end with an upwardly projecting lip, or flange, for engaging the side of the board which is to be worked.

KNIFE.—B. T. TRUEBLOOD, Kirkland, Wash. The improvement refers more particularly to knives such as can be easily folded, and each of which consists of a handle, a blade holder, and a removable blade adapted to be mounted in the blade holder, the blades that are used for this purpose being preferably the partly used or discarded blade of the ordinary safety razor.

FRUIT-CLEANER.—L. B. SKINNER, Dunedin, Fla. Mr. Skinner's invention is an apparatus for use in cleaning fruit, such as oranges, lemons, and apples, the operation being effected by means of rotary and reciprocating brushes arranged for conjoint and simultaneous action. It is also applicable to cleaning certain vegetables and other products.

STROPPING-MACHINE.—A. A. PRATT, New York, N. Y. This machine strops razor blades, knives and other cutting implements, it being arranged to hold one side of the cutting edge of the blade in contact with a revolving stropping roller, and on turning the roller in the reverse direction to automatically reverse the blade relative to the roller, with a view to bring the other side of the cutting edge in contact with the roller.

SAFETY-RAZOR.—A. A. PRATT, New York, N. Y. The invention pertains to safety razors having thin flexible blades, and its object is to provide a razor arranged to permit the user to shave with a shearing cut, to allow convenient insertion and removal of the razor blade and casing after use and to give the desired rigidity to the blade in the razor frame.

FISHING-TACKLE.—T. PEDERSEN, Wallace, Idaho. This inventor provides a tackle adapted to swirl and flash; provides a light reflecting and refracting attachment for the tackle; provides a tackle which may be readily packed within a small compass; provides a construction whereby the same may be readily changed to vary speed of operation; and provides a construction whereby hooks may be attached to the swirling body of the tackle.

SPANNER WITH AUTOMATIC PARALLEL LOCKING ACTION.—E. F. MAITRUGUE, 68 Grande Rue, Pontarlier (Doubs), France. The spanner has automatic parallel tightening or locking action, having a head adapted to revolve under the action of a special operating lever about an axis connecting the same with one of the two branches of the handles. This pivoting motion has for its purpose to cause the displacement of a jaw forming part of the spanner and provided for this purpose with a rack gearing with a toothed sector cut on the principal branch of the handle.

COUNTERBORE.—J. F. LEBARON, Ridgway, Pa. Among the principal objects this invention has in view are: to provide a pilot to hold the cutting tool by being clamped thereon; and to provide means for retaining the pilot and cutting tool in the tool holder, said means being removed from contact with the wall of the hole being bored.

SAW-FILING DEVICE.—J. S. GWYNNE, Reubens, Idaho. In this case the invention comprises a frame having parallel side ribs arranged longitudinally and spaced apart vertically and provided in its upper portion with pairs of end slits, U-shaped clips adapted for insertion in and removal from the slits, to receive the ends of the file, and a clamp-screw inserted through the top middle part of the frame.

WINDOW-SASH HOLDER.—F. E. ERICKSON, Marquam Ore. Wheels are provided which project through an opening in a plate of the holder, to engage the window jamb when it is raised, there being a bolt which projects through a slot in a spring member engaging the wheels, a nut engaging the bolt and pressing on the spring member to retard the rotation of the wheels, which permits of the adjustment of the holder for a light or heavy sash.

FISHING-LINE-DRYING REEL.—F. H. DARROW, Albion, Mich. This collapsible reel is adapted to be attached to a rod, and also to receive the line and the reel thereon, for the purpose of drying the same after using. The device may be secured to rods of varying size, and extended for the purpose of drying a fishing line or folded when not in use.

Heating and Lighting.

ADJUSTABLE LAMP BRACKET.—ANSEL P. SMITH, Smithville South, L. I., N. Y. The invention here illustrated provides a portable bracket for lamps which is extensible vertically and horizontally. It may be mounted at any

ADJUSTABLE LAMP BRACKET.

suitable location, and it is arranged for use as a holder for gas burners, a flexible tube being connected therewith. A lamp basket is rigidly secured to the outer section of the bracket, and in this the lamp body is supported.

BURNER.—A. OTTO, Fredonia, Kan. An object here is to provide a burner in which crude oil can be efficiently burned to give a maximum of heat with a minimum of waste, which can be used with stoves or burners of different kinds and for different purposes, which can be easily adjusted, which is simple and compact in form, and which requires little attention when in use.

OIL-BURNER.—G. F. MOODY, Altoona, Pa. The inventor's aim in this instance is to provide a burner which is highly effective as a means for welding metal parts together, is economical in the consumption of liquid fuel, affords a hydrocarbon vapor that issues from the burner in blue jets of flame, and is adapted for useful effect as a heating medium that may be utilized for different purposes.

Household Utilities.

QUICK-LUNCH CABINET.—W. E. KELLOGG, Inglewood, Cal. This invention has reference to a cabinet for use in light-housekeeping, the object of which is to combine in one article of furniture all the facilities necessary for the preparation and service of a meal, so that persons living in contracted quarters may be enabled to get their own meals.

MATTRESS.—D. B. MICHIE, Chicago, Ill. This device has means whereby it can be rendered more rigid than the ordinary mattress, and therefore can be more easily handled, and which further has flexible bands encompassing it, these bands serving to prevent the filling from compressing at certain points, as well as affording grips, so that the mattress can be more easily turned over by hand.

WINDOW-CHAIR.—J. J. RONAN, Jersey City, N. J. More particularly the invention relates to supports adapted to be temporarily secured to a window casing or window sill to support a person, washing the exterior of a window. The parts making up the chair can be readily folded to occupy a minimum space when not in use. A person seated in the chair cannot readily look downward from a height.

Machines and Mechanical Devices.

BELT-SHIFTER.—A. P. REDDEN, New York, N. Y. This invention conserves the power applied, while the machine is not in use; maintains the loose pulley as tight when the machine is in operation; provides means for readily removing the belt while the driving shaft is in motion; and provides mechanism including a shipping lever for starting or stopping with facility at the operator's will.

MACHINE-BRAKE.—S. MOORE, Monticello, Ind. The object of the present invention is to provide a brake of very powerful mechanism which will be especially adapted for traction engines, dredges, steam shovels, and the like, where a powerful, quick acting, self locking and quick releasing brake is desired.

AUTOMATIC WEIGHING-MACHINE.—S. CIARKOWSKI, Jersey City, N. J. The purpose here is to provide a machine more especially designed for weighing flour, corn, sugar, coffee, wheat and other materials in loose or granular form, and arranged to permit convenient packaging of the material according to a predetermined weight, and which may also be used for weighing liquids, such as oil and water.

SLIDING-DOOR-LOCKING DEVICE.—J. KOHN, New York, N. Y. The device is more especially designed for use on doors leading to elevator shafts and the like, and arranged to securely hold the door locked against open-

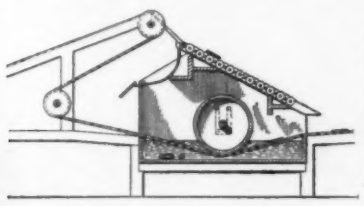
ing by a person intending to make use of the elevator, to allow the elevator attendant to readily unlock the door and open it for ingress and egress of passengers, and to permit of locking the door for the night both from the loft side of the building and the cage, to prevent opening of the door from either side by unauthorized persons.

SANDING-MACHINE.—Z. P. CHARPENTIER, Auburn, Maine. The aim of this invention is to provide a machine for scouring or sanding the heels of boots, shoes and the like, whereby the length of time necessary and the number of operations requisite, are decreased, and in which the parts can be adjusted so that a right-handed and a left-handed operator can use the machine equally well.

COMBINATION DREDGE AND CONVEYER.—F. P. EASTMAN, New York, N. Y. The purpose in this invention is to provide a combination more especially designed for dredging harbors and other water-ways of soft or hard material, and arranged to insure a ready and easy filling of the bucket and hauling the same, without danger of spilling the contents, to the place of discharge.

ROAD-GRADER.—O. A. NESS, Zumbrota, Minn. The invention provides a machine whereon a road bed may be leveled and rolled simultaneously; provides a mechanism wherein the excess material constituting the surface is conveyed to, and deposited in the path of a pressure roller; provides a mechanism the operation of which may be varied at will; and provides a mechanism for manipulating the various parts constituting the grader.

DEVICE FOR DIPPING LUMBER.—WILLIAM L. BATEN, care Thomas J. Baten, Beaumont, Texas. The invention is an improvement in machines known as "soda dip" machines, used in connection with a sawmill, for passing the lumber through a soda bath. This is necessary when the lumber is air dried,



DEVICE FOR DIPPING LUMBER.

to prevent bluing or mildewing. Heretofore, the entire output of a mill has been passed though the soda bath, whereas usually only 30 per cent needs to be dipped. The invention provides means for passing only such lumber through the soda tank as determined by the operator or grader

Railways and Their Accessories.

FISH-PLATE CHAIR FOR RAILWAY-RAILS.—F. W. POOL, Havre, Mont. This invention provides a joint for railway rails embodying fish-plates and chairs for uniting and supporting the ends of the said rails; and provides a structure having means exclusive of the fish-plate bolts upholding the fish-plates in rigid relation to the railway rails.

Pertaining to Vehicles.

PUMP-OPERATING MECHANISM FOR AUTOMOBILES.—L. A. MORGAN, Richmond, Ind. The purpose of this invention is to provide a mechanism which may be readily carried on the vehicle and which when inserted beneath a single rear wheel thereof, may be operated upon the starting of the engine, so that anyone of the other three wheels of the vehicle may be inflated, or the pump used for any other purpose.

COMBINED BUFFER AND FENDER.—G. HIPWOOD, New York, N. Y. This combined buffer and fender may be used on any vehicle propelled by motive power. An object of the inventor is to provide a device which will give a soft, yielding resistance to a person or object struck, and tend to shunt the obstacle off to one side beyond the reach of the vehicle wheels.

VEHICLE-WHEEL.—G. DORFFEL, Fruitvale, Cal. This invention refers to wheels mainly constructed of metal, so disposed that the rim will have sufficient elasticity to absorb shocks due to traverse on a rough road bed; and provides novel details of construction for a vehicle wheel, which afford a strong, light, durable and practical wheel, and which may be employed for vehicles of heavy or light character.

Designs.

DESIGN FOR A LAMP-POST.—W. W. BOSWORTH, New York, N. Y. In this design the intention is carried out of making a post much more attractive than the ordinary. The lines of the column's beautiful curves under the glass top to the base show extreme simplicity. The ornamentation runs down through this column and through a gracefully spreading base which is fortified with heavier ornamental designs.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12281) C. D. asks: When a coil for make and break is operated self-induction takes place and it produces a fat, heavy spark that even may be used for transmitting a wireless signal for short distances. Is this because self-induction increases the voltage at break, as for wireless work high voltages are required? This case applies, too, to the common electric bell, that may be used as a shocking coil. In fact, what is the relation between self-induction and this rise of potential? A. Self-induction always takes place whenever a break is made in a current which is traversing a coil of wire. Each turn of the coil acts upon the other turns to induce in them an electromotive force or voltage, just as the primary coil acts upon the secondary in a transformer. The self-induction varies as the number of turns in the coil, and as the number per unit of length. The length is usually measured in centimeters. The unit is the henry, and the formula is complicated. Foster, in his Electrical Engineer's Pocket Book, page 64 and on, gives the mathematical work in part. We send the book for $5 postpaid. 2. Why does lightning occur at night, especially in summer, without thunder? In this case lightning is between clouds, without touching the earth. It seems to me that thunder should invariably follow each discharge. A. At any time lightning may occur without thunder, which is simply the sound made by the air rushing back into the space from which the lightning has just driven it, chiefly by its heating power. The light can be seen much farther than the sound can be heard, especially at night, when the light is seen against the clouds after dark. The discharge took place so far away that the sound of the thunder did not reach the car, but the light reached the eye. Such lightning is often called heat lightning, but there is no good reason for the name. Thunder is never heard to any very great distance.

(12282) J. N. says: Where can I get information on the salting or smoking of fish and how to coat a piece of wood, that will not waterlog. In other words, I want some substance to paint fishing floats, that would not materially add much to their weight. A. We regret to state that we do not know of any book now in print treating on the salting or smoking of fish. The canning of all kinds of food products is treated in the following books on canning, which we can supply: "The Art of Canning and Preserving as an Industry," by Pacrette, price $5; "Complete Course in Canning," price $5. No coating will prevent wood from waterlogging in time, except the saturation of the wood with some substance such as oil of creosote. Creosoting requires that the piece of wood be placed in a vacuum chamber and all the air exhausted, after which the creosote is allowed to soak into the wood and penetrate to the center. For your purposes, you can get very fair results if the pieces of wood are not too large, by soaking them in hot linseed oil, or even crude petroleum.

(12283) F. Y. asks: Will you take the trouble to inform me as to the comparative strength, endurance, and wearing qualities of vanadium steel as compaed with other good steel, as used in the construction of automobile parts? A. It has a very high tensile strength and ductility. With these high tensile properties the steel behaves under bending and twisting like mild steel of excellent quality. It can be welded, it shows resistance to impact equal to that of excellent quality hard steel of only half its tensile strength, and above all its power of resisting alternations of stress seems to be increased beyond that of any other steel. The following figures represent the average of a large number of tests:

	Ultimate Tensile Strength, Tons.	Impact Test Blows.	Alternations of Stress.
Carbon steel, mild	22½	..	100
Carbon steel, "forging quality"...	31	25	120
Nickel steel, "forging quality"...	39	..	100
Vanadium steel...	53	25	160
Vanadium steel, annealed 800 deg..	39	60	190

NEW BOOKS, ETC.

ABNORMAL PSYCHOLOGY. By Isador H. Coriat, M.D. New York: Moffat, Yard & Co., 1910. 325 pp. Price, $2.

Dr. Coriat has performed a signal service in this book by placing before a wide class of readers in fairly popular language, what is known of hypnotism, hysteria, and allied abnormal phenomena. Dr. Coriat discusses at greatest length that curious dissociation of the personality which has received the attention of eminent psychologists, the most shining example of which is probably recorded in Dr. Prince's remarkable book, "The Dissociation of a Personality." Most valuable are the chapters on hypnosis, which Dr. Coriat defines as "a special mental state, an artificial dissociation of consciousness, strongly resembling, and in some cases absolutely identical with, normal absentmindedness, but more intense and protracted, induced by suggestion and readily terminated by suggestion." It was but natural that in the discussion of hysteria, the splendid work of Charcot and Freud should have been dealt with. Freud may well be regarded as the foremost authority on the therapeutic utilization of hypnosis in the treatment of hysteria.

DIE SCHULE DER PHYSIK. Besonders fuer das Selbststudium. Verfasst von Dr. Arthur von Oettingen. Braunschweig: Druck und verlag von Friedrich Viewig und Sohn, 1910. 622 pp.

As the title of this book indicates, it is intended both for teacher and pupil. Couched in question and answer form, the novice is made acquainted step by step with the principles of physics. Anyone who has a working knowledge of German and a high-school education ought to derive from this book a vast amount of instruction. We are pleased to see that the author has not shirked the duty of driving home to the pupil the necessity of studying mathematics in connection with physics. Indeed he has framed a series of ingenious questions which ought to awaken the mathematical sense of a scientifically-inclined pupil, and drive home to him how very frequently a mathematical expression will clearly and naturally express a physical law. To the younger pupil the question and answer form of the book will probably appeal because of its essentially human quality. The book is modeled upon Ostwald's "Schule der Chemie." The question and answer form has the merit of permitting the author to place in the mouth of his pupil errors of frequent occurrence, which he immediately proceeds to correct in the answers.

SIGHT-SEEING MAPS OF THE HUDSON RIVER; POINTS OF INTEREST VISIBLE FROM CAR WINDOWS AND POINTS OF INTEREST VISIBLE FROM THE DECK OR SALOON OF THE HUDSON RIVER STEAMERS. New York: W. H. Radcliffe, 1910. Price, 10 cents each.

This is a most novel idea which will add very much to the traveler's interest in going up or down the river, either by the railroad or by the boats. Each folder is about three feet long and is printed on both sides, giving a map of the river, with arrows pointing to all the places of interest. The work of compilation has been very well carried out and Mr. Radcliffe is to be congratulated on his novel map, which is certainly worthy of a considerable sale.

MISSION FURNITURE. HOW TO MAKE IT. Part II. Chicago: Popular Mechanics Company, 1910. 18mo.; 120 pp. Price, 25 cents.

The wonder is that a cloth-bound book profusely illustrated with working drawings can be produced and sold at such a very moderate price. The descriptions and illustrations are excellent.

ORNAMENTAL TURNING. By J. H. Evans. Philadelphia: David McKay, 1910. Three volumes. 160 pp. each. Price, $1 each.

The art of decorative turning necessarily embodies many distinct classes of work, which may be applied to either the surface, cylinder, or the shaping of compound solid forms, polygonal figures, and a variety of other distinct shapes; the different instruments being applied in combination with almost equal facility for all and any of them. The subject is rather too extensive for treatment in the compass of a single volume, therefore it has been thought wise to publish the book in sections. The whole forms a very excellent little series.

A DICTIONARY OF TERMS USED IN ARCHITECTURE AND BUILDING. New York: Industrial Publication Company, 1909. 18mo.; 104 pp. Price, 50 cents.

This is an excellent little glossary of architecture, published at a moderate price.

CAPTAINS OF INDUSTRY. By James Parton. Boston: Houghton, Mifflin & Co., 1910. 16mo.; 114 pp.

This is an up-to-date classic accompanied by excellent engravings, which add very much to the appearance of the book, which is intended for school readers. A number of inventors are included in the present volume, such as Sir Henry Bessemer, Peter Cooper, Alvan Clark, and others.

MODERN WORKSHOP HINTS. Describing Unusual and Rapid Ways of Doing Work. By Robert Grimshaw, M.E. Philadelphia: David McKay, 1910. 16mo.; 428 pp. Price, $2.

This work is intended as a companion to the author's Shop Kinks. It does not profess to aid the learner to work according to usual methods; it is devoted almost exclusively to emergency cases, and special and unusual ways of doing special and unusual work. It deals almost entirely with American practice. The book is well gotten up and is profusely illustrated by 528 engravings.

MODERN DYNAMOS AND BATTERIES FOR AMATEURS AND STUDENTS. By S. R. Bottone. Philadelphia: David McKay, 1910. 16mo.; 171 pp. Price, 75 cents.

This book has already attained a considerable reputation for a moderate-priced work on the subject. Some of the working drawings are rather small for the use of the amateur.

ELECTRICAL ENGINEERING FOR STUDENTS. By S. R. Bottone. Philadelphia: David McKay, 1910. 16mo.; 153 pp. Price, 75 cents.

This book gives full constructional details with all the appliances described, and carefully selected questions enable the student to test his knowledge from time to time. Part I. deals with magnetism and magnetic apparatus, while Part II. deals with statics and electrical instruments.

BACKWOODS SURGERY AND MEDICINE. By Charles Stuart Moody, M.D. New York: Outing Publishing Company, 1910. 100 pp. Price, 75 cents net.

A handy book for the prudent lover of the woods who doesn't expect to be ill but believes in being on the safe side. Common-sense methods for the treatment of the ordinary wounds and accidents are described—setting a broken limb, reducing a dislocation, caring for burns, cuts, etc. Practical remedies for camp diseases are recommended, as well as the ordinary indications of the most probable ailments. Includes a list of the necessary medical and surgical supplies.

THE AMATEUR ELECTRICIAN'S WORKSHOP. By S. R. Bottone. Philadelphia: David McKay, 1910. 16mo.; 114 pp. Price, 75 cents.

Among the various chapters are those devoted to the Making and Using of Wireless Telegraph Apparatus, Sparking Coils for Motors, How to Make a Wireless Telephone, etc.

A PRIMER OF ARCHITECTURAL DRAWING FOR YOUNG STUDENTS. By William S. B. Dana, B.S. New York: The William P. Comstock Company, 1910. 16mo.; 154 pp.

This is a progressive series of drawing work problems, and is the embodiment of the author's teachings in the Mechanics' Institute of New York city. The book appears to be an eminently practical one, and is rather different from anything which we have seen in the way of a mechanical drawing book in a long time. The detailed drawings are excellent.

SHOP PROBLEMS IN MATHEMATICS. By William E. Breckenridge, Samuel F. Mersereau, and Charles F. Moore. Boston: Ginn & Co., 1910. 12mo.; 280 pp. Price, $1.

This book aims to give a thorough training in the mathematical operations that are useful in shop practice, e. g. in Carpentry, Pattern-Making, Foundry Work, Forging, and Machine Work, and, at the same time, to impart to the student much information in regard to shops and shop materials. The mathematical scope varies from addition of fractions to natural trigonometric functions. Problems are graded from simple work in board measure to the more difficult exercises of the machine shop.

THE PRINCE AND HIS ANTS. By Vamba. New York: Henry Holt & Co., 1910. 12mo.; 275 pp. Price, $1.35 net.

Ciondolino is the little Italian boy who became an ant and had many thrilling experiences with other ants and wasps, and Vamba is the clever Italian writer who describes the happenings. American children should be very grateful to Miss Woodruff for translating what bids fair to be an Italian classic into English for the use of children. To be an ant in size and shape and habits and to live with ants and other insects, but all the time keep the memories and have the mind of a little boy, is plainly a combination which promises exciting situations. What little Ciondolino did in company with his sister in a world of butterflies and moths, Vamba promises to tell in another book. The present volume is edited by Vernon L. Kellogg of Stanford University, and is accompanied with many plates and colored illustrations.

THE RAILWAY LIBRARY. 1909. Compiled and Edited by Slason Thompson. Chicago: 1910. 8vo.; 403 pp.

This is a collection of noteworthy chapters, addresses, and papers relating to railways, mostly published during the year. Mr. Thompson is manager of the Bureau of Railway News and Statistics of Chicago. The book includes papers from the pens of James J. Hill, Sir George S. Gibb, John F. Wallace, J. Edgar Thomson, and others. It is an invaluable mine of information, which is of the greatest possible usefulness to all who are in any way interested in the subject of land transportation.

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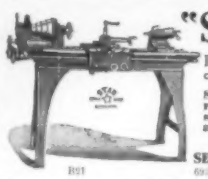

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SOME NEW METHODS OF ASTRONOMICAL DISCOVERY.

(*Continued from page 177.*)

that they no longer coincide, and all the lines appear double—as is well shown by the calcium line near the middle of the lower figure. The two great hydrogen lines on either side of it are too wide and fuzzy to be separated; but the one on the left in the lower figure (which must have been printed very much more lightly than the other by some screening process) shows that at the core it is really double, too; and several fainter double lines are visible.

These doublings repeat themselves regularly every two days. As during a complete revolution first one star and then the other approaches us, it is clear that the lines will appear double twice in a revolution, which, therefore, takes four days. The relative velocity of the two stars is almost 140 miles per second, and perhaps more, for we cannot allow for the effect of any possible foreshortening due to the direction of motion in the orbit never being straight toward the earth.

The distance of the pair from one another is not less than 7½ million miles, and their combined mass more than four times that of the sun. Their distance from us is, however, so great that their apparent separation in the sky is probably at most scarcely 1/50 as much as that of the closest pairs which can be seen double in our greatest telescope.

Turning finally to the sun, a very fine illustration of the way in which new phenomena are revealed by suitably devised methods of observation is afforded by the great eruptions associated with sun spots.

It has long been suspected that such phenomena exist, and occasional evidences of the more violent ones were obtained; but these eruptions consist for the most part of *transparent* gases, and the problem of detecting these in front of the sun's intensely luminous surface might indeed seem to be without solution.

The spectroscope again saves the situation. These gases, though generally transparent, absorb light of certain definite wave lengths—different from each chemical constituent of the gas. If we could isolate the light of one of these particular kinds, we would then see dark patches on the sun where gas of the corresponding sort was unusually dense or cool, and perhaps bright patches if in regions intensely heated, gas were coming up from the sun's interior.

This is actually done by the spectroheliograph—an instrument invented independently by Prof. Hale (now director of the great Mount Wilson Solar Observatory) and by M. Deslandres, in France. Its operation may be understood by returning for a moment to Fig. 6.

Suppose we form an image of the sun. Let the light from a small part of it pass through a narrow slit, and by means of a prism or other suitable device draw it out into a spectrum. Then if our slit is set upon a portion of the sun, where there are no eruptions of hot gas, we will have a spectrum crossed by dark lines, only much like the lower one in Fig. 6 (though by no means identical with it). But if we set on an eruption of hydrogen, for example, the hydrogen lines will show bright in our spectrum (as they do in the upper picture in Fig. 6).

Now if at the point where this spectrum is formed we set up a second slit, so arranged that the light corresponding to one of these hydrogen lines goes through the slit, and all other kinds are stopped, we would, looking through this slit, see light or (relative) darkness accordingly as the image of a region of the sun where there was or was not an eruption of hydrogen fell on our first slit. By moving an image of the sun over the first slit, and a photographic plate behind the second at a corresponding rate, we can thus get a picture of the

(*Concluded on page 190.*)

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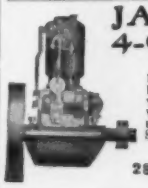
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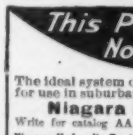
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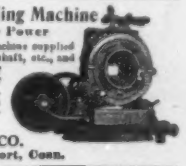
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(*Concluded from page 188.*)

sun showing the hydrogen eruptions bright on a darker ground.

Fig. 8 shows a number of such photographs of the region near two sun spots, taken by Mr. Fox at the Yerkes Observatory. The bright regions showing the existence and rapid changes of a great eruption 140,000 miles long, connecting the two spots, are conspicuous.

The photograph at the left, on which the background has a mottled effect like the skin of an orange, shows the distribution of heated calcium vapor; the others, on which a linear structure appears, that of a hydrogen (which is believed to represent a higher level in the sun's atmosphere). The structure in the latter shows a close connection with the sun spots, the dark streaks running into them like water into a whirlpool.

It was, in fact, on such photographs as these that Prof. Hale was able to show that a great mass of "dark" (i. e., cool or dense) hydrogen had been actually sucked in a spot, and so to establish the theory that the spots are actually vast vortices resembling tornadoes in the solar atmosphere.

But enough has already been told to make it plain how great a part ingenuity and patience, as well as great telescopes and clear skies, play in the advancement of our knowledge in what is in extent at least, the greatest of all its fields.

THE 1910 HARMSWORTH CUP RACE.

(*Continued from page 181.*)

3:30 P. M. of August 20th that the starting gun was fired. The "Zigorella" went over the line first, six seconds after the gun, followed nine seconds later by the "Dixie II." and "Pioneer" with bows even, and thirty seconds later by the "Nameless," whose engineers had trouble in getting her motor into action. The "Pioneer" shot ahead in a way that left no doubt of her superior speed. At one time at least she seemed to be making 40 miles an hour. But less than a mile away from the line on the first round she stopped. Traveling at her extreme speed, the only possible way of supplying circulating water to the cylinders is by means of a scoop under the bottom. Seaweed jamed the openings of the scoop and clogged the water supply, with the result that the cylinders became hot. When the engineer unscrewed the top of the float-feed chamber of the carbureter, gasoline overflowed and took fire. Before it was extinguished the insulation had been burned off the wires leading to three of the cylinders, so that thereafter the "Pioneer" had to run on nine cylinders only.

While the "Pioneer" lay to, the "Dixie II.," a mile behind, dashed up and finished her first round at 3:49:50. Her elapsed time was 19 minutes and 50 seconds, a most creditable showing when it is considered that she was carrying 300 pounds extra weight, represented by her new mufflers and a third man in her crew.

The "Zigorella" trailed after the "Dixie II.," but she was never really in the race. The "Nameless" did not finish the first lap. It was impossible to get her thirty-two cylinders to work in unison.

After 16 minutes and 21 seconds of idleness, the "Pioneer" started again. Her chance was hopeless. She finished the first round at 4:5:28. The "Dixie's" lead was far too great to be overcome, particularly with a crippled engine. The "Dixie II." finished her second round at 4:09:52, having completed the lap in 20 minutes and 2 seconds. At 4:22:59 the "Pioneer" finished her second round, having covered the ten nautical miles in 17 minutes and 31 seconds, an average speed of 34.55 nautical or 39.46 statute miles an hour—a wonderful showing under the circumstances.

The "Dixie II." finished her final round at 4:29:44 (elapsed time 19 minutes and 52 seconds), and the "Pioneer" at

(*Concluded on page 191.*)

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(*Concluded from page 190.*)

4:43:21, just 13 minutes and 37 seconds behind the "Dixie."

The "Dixie II." covered the 30 nautical miles in 59 minutes and 44 seconds, an average speed of 30.08 nautical or 34.7 statute miles an hour.

The "Zigorella" was towed in by the committee boat, her feed pipes having clogged at the first turn of the second round.

THE LESSONS OF THE RACE.

The "Dixie II." won by her steady and reliable running. But it is impossible that she shall ever successfully compete for the Harmsworth trophy again. The "Pioneer" is unquestionably a faster boat, and next year's American boat must be even faster than the "Pioneer."

The accident to the "Pioneer" emphasizes the fact that it is unfair to limit the contest for the Harmsworth Trophy to one race only. That feeling seems to be shared by most motor-boat yachtsmen. Indeed, immediately after the race there was an informal gathering of the official representatives of the Motor Yacht Club of Great Britain and the Motor Boat Club of America for the purpose of suggesting to Lord Northcliffe that hereafter a contest shall consist of three races instead of one race. So much expense is entailed in sending a boat to compete for the trophy, that it seems rather hard that a trivial accident, like that which happened to the "Pioneer," should utterly spoil the chances of a contestant.

Judicial Notice of a Mule's Kick.

The natural inclination of a mule to kick, even when in a serene and imperturbed frame of mind, seems to have been the proximate cause of plaintiff's injuries in Tolin vs. Terrell, 117 Southwestern Reporter, 290. Plaintiff drove his mule on a ferryboat some three feet from the treadmill horse, which propelled the boat. There was no screen between the treadway and the driveway, and it was claimed the treadmill horse bit the mule just as plaintiff went near his heels to gather up the lines. It was not clear whether plaintiff was injured as the result of walking behind his mule without warning and raising the lines or because the horse bit the mule. In reference to the amiable disposition of this mule the court remarks: "The mule in question was three years old. In spite of the fact that there was testimony to show that this mule was of so gentle a disposition that the children could play at its heels, it is a matter of common knowledge and common experience that there is no telling when or under what circumstances a mule will or will not kick. The only way to escape danger from the feet of a mule is not to go within the radius of its heels. He who goes within these limits assumes the risk of being kicked."

Trials were made in Berlin recently with an interesting machine which has been invented by a German aviator named Grawert, and is designed to be used as an automobile, motor boat, and aeroplane. This machine, which, on account of its peculiar and elegant shape, might be called an "aerial torpedo boat," is a combination of biplane and monoplane. It is equipped with a 50 horsepower Anzani engine, which is to propel the machine, with four passengers, at the rate of 100 to 120 kilometers per hour. The inventor's aim is to construct an efficient military machine. To convert the flying machine into an automobile the carrying planes are unfastened, and then fixed to the body of the machine, so as to form the side walls of the automobile. The process of reconverting the flying machine into an automobile in any place where it may happen to be is calculated to take 30 minutes. During the trials on the uneven ground of the Tempelhofer Feld, the large parade in Berlin, appreciable speeds were reached with four passengers in the chassis. The machine is to be propelled on land, on the water, and in the air by an air propeller.

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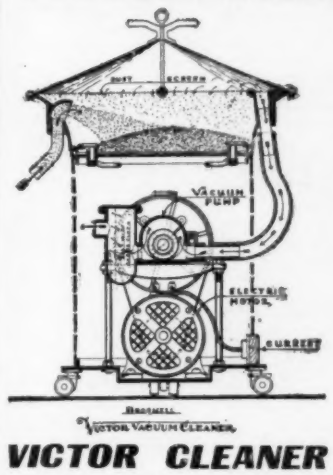

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In SCIENTIFIC AMERICAN SUPPLEMENT 1605 Mr. Sanford E. Thompson thoroughly discusses the proportioning of Concrete.

SCIENTIFIC AMERICAN SUPPLEMENT 1578 tells why some fail in the Concrete Block business.

SCIENTIFIC AMERICAN SUPPLEMENT 1608 contains a discriminating paper by Ross F. Tucker on the Progress and Logical Design of Reinforced Concrete.

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Valve, water sealed producer, F. G. Hobart	967,919
Vapor and steam burner, G. A. Stafford	967,994
Vault head, A. W. Kurz	967,940
Vehicle antivibration device, W. A. & C. L. Penfield	968,250
Vehicle driving gear, E. Byars	968,447
Vehicle, dumping, A. R. Piper	967,970
Vehicle, propulsion, W. & H. Hopkins	968,355
Vehicle seat, Clarke & Bachman	968,510
Vehicle steering device, O. Winkler	968,303
Vehicle top, Ranley & Schirack	968,193
Vehicle wheel, L. G. Fleming	968,337
Vent for liquid containing tanks, etc., V. V. Overturf	968,394
Vise, L. R. Blackmore	968,442
Voting machine, vote printing, D. L. Newcomb	968,070
Wagon, M. Kraeski	967,937
Wagon and car, combination, D. F. Reinheimer	968,419
Wagon, dumping, W. L. Collins	968,511
Washboiler, R. J. Fitzgerald	968,041
Washer. See Bottle washer.	
Washing machine, F. B. Raymond	968,413
Washing machine gearing, Winger & Johnston	968,302
Washing machine water motor, J. D. Wiltome	968,016
Watch, stem winding and setting, F. Weingart	968,436
Water closet, S. A. Quinn	968,411
Water heater, G. D. Cooper	968,129
Water purifier and boiler cleaner, J. A. Ray	968,077
Weather strip, J. Kammerer	968,163
Weaving machine, slat, E. Walton	968,009
Weighing device, E. S. Kneeland	967,935
Well adjuster, oil, L. C. Moore	968,181
Wheel, W. W. Neighbour	968,392
Wheel fender, C. R. Folsom	968,220
Wheelbarrow attachment, A. Lassky	968,248
Windmill, R. W. Vaughan	968,005
Window, attic, M. Just et al	968,480
Window bracket, J. H. Ashmead	968,311
Window frame, ventilated, D. J. Murnane	967,955
Wire stripping device, F. A. Swan	967,998
Wood scoring device for planes and the like, C. Bodner	968,508
Wrapping various articles, machine for, F. Giroud	968,146
Wrench, Dethlefs & Wisner	967,889
Wrench, W. E. Golden	967,889
Wrench, M. K. Olson	967,962
Wrench, O. Zimmermann	968,108
Wrench, bushed combination casing, W. L. Dunn	968,454
Wrist pin, S. B. Welcome	968,213
Writing machine, Hess & Stoughton	967,915, 967,916
Yoke, neck, J. N. Novotny	968,393

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since October 4th, 1859, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

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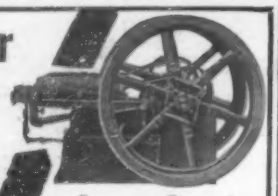

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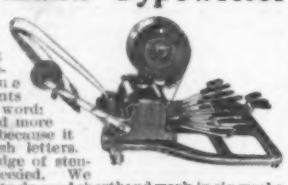

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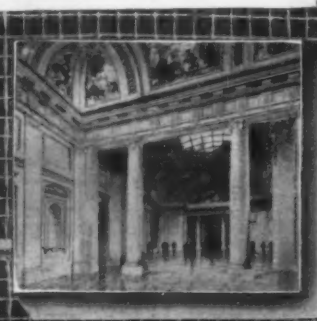

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